THE BULLETIN

OF THE

AMERICAN CERAMIC SOCIETY

Volume 16 FEBRUARY, 1937 Number 2

Organizer and First President, Hazel-Atlas Glass Company. See page 73.

CHARLES N. BRADY

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THE BULLETIN OF THE AMERICAN CERAMIC SOCIETY

Volume 16 February, 1937 Number 2

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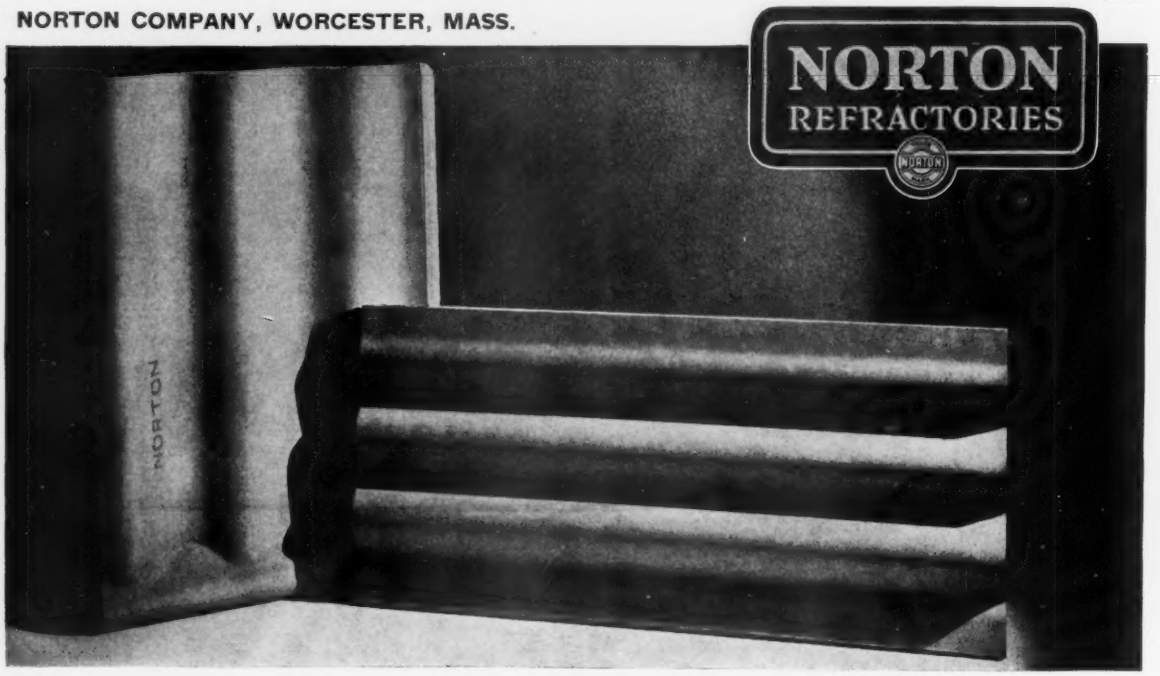

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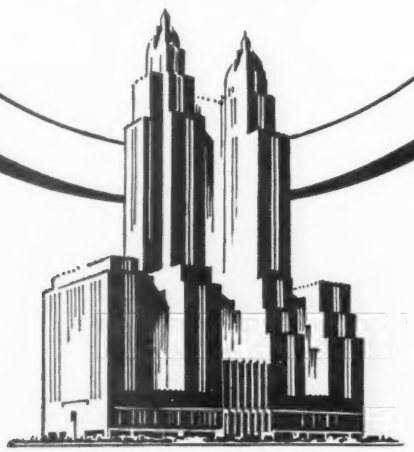

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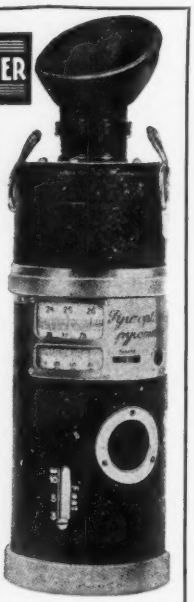

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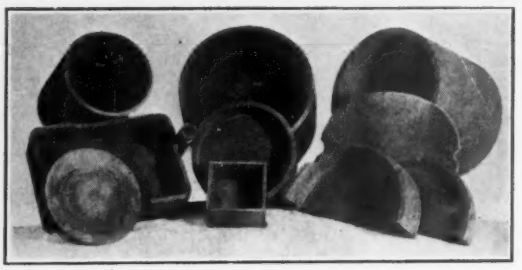

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The Seaboard Feldspar Co.
The Vitro Mfg. Co.

Fire Brick
Carborundum Co.
Corhart Refractories Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Norton Co.

Fire Brick—Process Equipment
Lancaster Iron Works, Inc.

Fire Clay
Kentucky Clay Mining Co.
Spinks Clay Co., H. C.

Flint
Ceramic Color & Chemical Mfg. Co.
Consolidated Feldspar Corp.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
The Porcelain Enamel and Mfg. Co.

Flint Pebbles
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Consolidated Feldspar Corp.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Floors (Non-Slip)
Norton Co.

French Flint
Consolidated Feldspar Corp.
Paper Makers Importing Co.

Frit
Allied Engineering Co.
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.
Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Fuel Oil Systems and Control, Stokers
Bethlehem Steel Co.
Simplex Engineering Co.

Furnaces
Allied Engineering Co.
Carborundum Co. (*Carboradiant*)
Chicago Vitreous Enamel Product Co.
Denver Fire Clay Co.
The Hommel Co., O., Inc.
Simplex Engineering Co.

Glass Bending Ovens, Glass Decorating Machines
Simplex Engineering Co.

Glass Equipment
Hartford-Empire Co.
Lancaster Iron Works, Inc.

Glass Melting Pots (Open and Covered)
Pittsburgh Plate Glass Co.

Glass Melting Tanks and Furnaces
Pittsburgh Plate Glass Co.
Simplex Engineering Co.

Glass Thickness Gauge
Bausch & Lomb Optical Co.

Glaze and Body Spar
Ceramic Color & Chemical Mfg. Co.
Consolidated Feldspar Corp.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
The Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

Glazes and Enamels
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. H. Chemicals Dept.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
The Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Glaze Spar
Ceramic Color & Chemical Mfg. Co.
Consolidated Feldspar Corp.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.
Paper Makers Importing Co.

Goggles
Willson Products, Inc.

Gold
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc. R. H. & Chemicals Dept.
The Hommel Co., O., Inc.
The Vitro Mfg. Dept.

Gold Decorations
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Co.

Granulators
Hardinge Company, Inc.
Lancaster Iron Works, Inc.

Grinding Wheels
Carborundum Co. (*Carborundum and Aloxite*)
Chicago Vitreous Enamel Product Co.
Norton Co. (*Alundum-Crystolon*)

Hearths
Carborundum Co. (*Carbofrax* heat treating)
Corhart Refractories Co.
Electro Refractories & Alloys Corp.
Norton Co. (*Crystolon*)

Hearths (Fused Al_2O_3, SiC)
Electro Refractories & Alloys Corp.

Hearths (High Aluminous Clay, Electrically Sintered Aluminum Oxide, Silicon Carbide)
Carborundum Co.
Norton Co.

Hose (Air and Fluid)
The DeVilbiss Co.

Iron (Enameling)
American Rolling Mill Co.
Bethlehem Steel Co.

Iron Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.
The Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

Kaolin
Ceramic Color & Chemical Mfg. Co.
Consolidated Feldspar Corp.
Edgar Brothers Co.
Edgar Plastic Kaolin Co.
Hammill & Gillespie, Inc.

The Hommel Co., O., Inc.
Paper Makers Importing Co.
United Clay Mines Corp.
The Vitro Mfg. Co.

Kellog AA Refractories
Electro Refractories & Alloys Corp.

Kilns, China (Decorating)
Allied Engineering Co.
Denver Fire Clay Co.
Drakenfeld & Co., B. F.
The Hommel Co., O., Inc.
Simplex Engineering Co.

Kiln Furniture (Silicon Carbide, Semi-Silicon Carbide)
Electro Refractories & Alloys Corp.

Kyanite
Celo Mines, Inc.

Kryolith
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Laboratory Ware
Norton Co.

Lehr Tile (High Aluminous Clay, Electrically Sintered Aluminum Oxide, Silicon Carbide)
Carborundum Co.
Electro Refractories & Alloys Corp.

Lehrs
Simplex Engineering Co.

Lehrs (Electric or Fuel Heated)
Simplex Engineering Co.

Lehr Loaders
Simplex Engineering Co.

Linings (Furnace Refractory, Block Refractory Plate, Brick and Tile)
Carborundum Co.
Chicago Vitrebus Enamel Product Co.
Corhart Refractories Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Norton Co.
Pittsburgh Plate Glass Co.
The Vitro Mfg. Co.

Magnesia (Fused)
Electro Refractories & Alloys Corp.

Magnesia (Sintered, Calcined)
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.
Norton Co.
The Procelain Enamel and Mfg. Co.

Magnesite
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Manganese
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc. R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Manganese (Oxide)
Ceramic Color & Chemical Mfg. Co.
Corhart Refractories Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.

Masks (Breathing)
The DeVilbiss Co.
Willson Products, Inc.

Metals (Porcelain Enameling)
American Rolling Mill Co.
Bethlehem Steel Co.

Microscopes (Polarizing)
Bausch & Lomb Optical Co.

Minerals
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Mixers (Batch)
Lancaster Iron Works, Inc.

Mold Sanders
Lancaster Iron Works, Inc.

Muffles (Furnace)
Allied Engineering Co.
Carborundum Co. (*Carbofrax*)
Chicago Vitreous Enamel Product Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Norton Co.
Pittsburgh Plate Glass Co.
Simplex Engineering Co.

Muffles (Laboratory)
Electro Refractories & Alloys Corp.

Mullite (Refractories)
Electro Refractories & Alloys Corp.

Muriatic Acid
Denver Fire Clay Co.
The Hommel Co., O., Inc.

Nitrates (Cobalt, Sodium)
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Non-Gro Refractories
Electro Refractories & Alloys Corp.

Norbide (Norton Boron Carbide)
Norton Co.

Olivine
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.

Opacifiers
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I. & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Metal & Thermit Corp.
The Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Overglaze Colors
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.

Oxides
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Metal & Thermit Corp.
Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Palladium Decorations
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.

Pins
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Potters Supply Co.

Platinum Decorations
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.

Polariscopes
Bausch & Lomb Optical Co.
Simplex Engineering Co.

Porcelain Enameling Service (Practical)
American Rolling Mill Co.
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Hardinge Company, Inc.
The Hommel Co., O., Inc.
The Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Porcelain Enamels
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
The Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Potash (Carbonate)
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.
Solvay Sales Corp.
The Vitro Mfg. Co.

Producer Glass Plants
Simplex Engineering Co.

Pug Mills
Lancaster Iron Works, Inc.

Pyrophyllite
The Seaboard Feldspar Co.

Pyrometer Tubes
Carborundum Co.
Electro Refractories & Alloys Corp.
Montgomery Porcelain Products Co.

Pyrometer Tubes (Refractory and Hard Porcelain)
Denver Fire Clay Co.
McDanel Refractory Porcelain Co.
Montgomery Porcelain Products Co.
Norton Co.

Pyrometers (Optical, Radiation, Surface, Immersion, Needle)
Pyrometer Instrument Co.

Pyrometric Cones
The Edward Orton, Jr., Ceramic Foundation

Raw Material Handling Equipment
Simplex Engineering Co.
Lancaster Iron Works, Inc.

Refractometers
Bausch & Lomb Optical Co.

Refractories
Carborundum Co.
Corhart Refractories Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Kentucky-Tennessee Clay Co.
Norton Co.
Pittsburgh Plate Glass Co.

Refractory Materials
Carborundum Co.
Chicago Vitreous Enamel Product Co.
Corhart Refractories Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Kentucky-Tennessee Clay Co.
Norton Co.
Pittsburgh Plate Glass Co.
Titanium Alloy Mfg. Co.

Represses (Automatic)
Lancaster Iron Works, Inc.

Respirators
Chicago Vitreous Enamel Product Co.
The DeVilbiss Co.
The Hommel Co., O., Inc.
Willson Products, Inc.

Rutile
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc. R. & H. Chemicals Dept.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Saggers
Carborundum Co.
Electro Refractories & Alloys Corp.
Norton Co.
Potters Supply Co.

Salt Cake
American Potash & Chemical Co.
The Hommel Co., O., Inc.

Sandblast Helmets
Willson Products, Inc.

Sand Grinder and Sifters
Lancaster Iron Works, Inc.

Saponin
The Hommel Co., O., Inc.

Selenite of Sodium
Drakenfeld & Co., B. F.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Selenium
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Sheets (Enameling Iron)
American Rolling Mill Co.
Bethlehem Steel Co.

Silica (Fused)
Electro Refractories & Alloys Corp.
The Hommel Co., O., Inc.

Silicate of Soda
Ceramic Color & Chemical Mfg. Co.
Denver Fire Clay Co.
The Hommel Co., O., Inc.

Silicon Carbide
Carborundum Co.
Electro Refractories & Alloys Corp.
Norton Co.

Silicon Carbide Firesand
Carborundum Co.

Sillimanite Refractories
Electro Refractories & Alloys Corp.

Sillimanite (Synthetic)
Pittsburgh Plate Glass Co.

Slabs (Furnace)
Carborundum Co.
Electro Refractories & Alloys Corp.
Ingram-Richardson Mfg. Co. of Indiana, Inc.

Norton Co.
Pittsburgh Plate Glass Co.

Soda Ash
American Potash and Chemical Corp.
Ceramic Color & Chemical Mfg. Co.
Denver Fire Clay Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.
Pittsburgh Plate Glass Co.
Solvay Sales Corp.
The Vitro Mfg. Co.

Sodium Antimonate
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
The Vitro Mfg. Co.

Sodium Fluoride
Ceramic Color & Chemical Mfg. Co.
Denver Fire Clay Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Sodium Silica Fluoride
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.

Soot Blowers
Simplex Engineering Co.

Special Machines
Simplex Engineering Co.

Spar
Ceramic Color & Chemical Mfg. Co.
Consolidated Feldspar Corp.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
The Vitro Mfg. Co.

Spray Booths
The DeVilbiss Co.

Spraying Equipment
The DeVilbiss Co.

Spurs
Potters Supply Co.

Stacks
Lancaster Iron Works, Inc.

Steel Plate Construction
Bethlehem Steel Co.
Lancaster Iron Works, Inc.

Stilts
Potters Supply Co.

Sulfuric Acid
Denver Fire Clay Co.
The Hommel Co., O., Inc.

Talc
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
The Hommel Co., O., Inc.
Paper Makers Importing Co.

Tanks
Simplex Engineering Co.

Tank Blocks
Corhart Refractories Co.
Pittsburgh Plate Glass Co.

Tanks (Pickle)
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.

Tanks for Raw Material Steel or Concrete
Bethlehem Steel Co.
Lancaster Iron Works, Inc.

Tile (Floor)
Norton Co.

Tile (Muffle)
Carborundum Co.
Electro Refractories & Alloys Corp.
Norton Co.

Tile (Refractory)
Carborundum Co. (*Carbofrax*)
Chicago Vitreous Enamel Product Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Norton Co.
Pittsburgh Plate Glass Co.

Tile (Wall)
Denver Fire Clay Co.

Tin Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
The Vitro Mfg. Co.

Titanium
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
The Hommel Co., O., Inc.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Titanium Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Trucks
Lancaster Iron Works, Inc.

Tubes (Insulating)
Carborundum Co.
McDanel Refractory Porcelain Co.
Norton Co.

Tubes (Pyrometer)
Carborundum Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
McDanel Refractory Porcelain Co.
Montgomery Porcelain Products Co.
Norton Co.
Pittsburgh Plate Glass Co.

Uronium Oxide (Yellow-Orange-Black)
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Vitro Mfg. Co.

Water Softening Plants
Simplex Engineering Co.

Wet Enamel
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.
The Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Whiting
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc. R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
The Vitro Mfg. Co.

Winding Drums
Lancaster Iron Works, Inc.

Zinc Oxide
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Zirconia
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

North Carolina Feldspar
North Carolina China Clay
Georgia China Clay
Representing: Georgia Saggar Clay
North Carolina Feldspar Corp.
Carolina China Clay Co.
Boyd & Sant Clay Co.
John Sant Company
Pulverized Saggar Grog
Broken Saggars
Broken Bisque & Porcelain
RICHARD C. SANT
EAST LIVERPOOL,
OHIO

McDANEL REFRACTORY PORCELAIN COMPANY
Manufacturers of
PORCELAIN TUBES PROTECTION TUBES
INSULATING TUBING and BEADS
BEAVER FALLS PENNSYLVANIA

BACKGROUND

New products—unusal designs—changing conditions: all make additional production problems . . . . . In the solution of these problems, Harshaw contributes real assistance. Within the Harshaw organization are men experienced not only in porcelain enamel, glass and pottery, but also others, expert in plating, metal finishing, paints, printing inks, etching and pigments. . . . . It is surprising how often assistance from these apparently unrelated fields aids in the solution of ceramic problems.

This collective experience is at your disposal at all times. . . . . Make use of it whenever you'd like a little help.

THE HARSHAW CHEMICAL CO.

MANUFACTURERS • IMPORTERS • MERCHANTS

Offices and Laboratories: Cleveland, Ohio

— Quality products since 1892 —

New York . Philadelphia . Chicago . Detroit . Pittsburgh . Cincinnati

East Liverpool . Los Angeles . San Francisco

Works at Cleveland and Elyria, Ohio and Philadelphia, Pa.

FUEL DATA
for a Large Continuous Bridgewall Tank

Total Days Life (to date)	574	Total Gas to Hold Temperature for Total Idle Days (M)	81,954
Total Producing Days	400	Total Gas Consumed on Operating Days (M)	321,872
Total Glass Delivered (Tons)	44,524	Melting Area Sq. Ft.	627
Total Gas Consumed (M)	403,826	Tons Glass Pulled per Operating Day	111.3
Useful Gas 3000 X Glass Produced (M)	133,572	Rating Sq. Ft./Ton/Day	5.63
Total Gas to Hold Temperature (M)	270,254	Cu. Ft. Gas per Ton of Glass	7,230
Gas to Hold Temperature per Day (M)	471		

WHAT DETERMINES FUEL PERFORMANCE?

ONE of the questions frequently asked the manufacturer of tank blocks is: "What kind of fuel performance can I expect in connection with your products?" That, of course, is a question to ask the tank designer and operator—NOT the supplier of the blocks.* But tabulated above are the fuel figures for a large bridgewall type continuous furnace melting clear flint soda-lime glass—figures which are more or less typical of *properly-designed* tanks, regardless of the materials with which they are constructed. The sidewalls from doghouse to machines were Corhart . . . . . The figures are *not* for some small "spot period"—they are for the first 574 consecutive days of the campaign. ☆ ☆ ☆

***The fuel efficiency of a glass furnace is a matter of engineering, design and operation. It is not a function of the particular materials of which its sidewalls are constructed.**

Studies of fuel performances in various plants and on various fuels show conclusively that furnace design and operation are the controlling factors in fuel efficiency. We would welcome an opportunity to discuss the subject with you. *Address:* Corhart Refractories Co., *Incorporated*, 16th and Lee Sts., Louisville, Ky. *In Europe:* L'Electro Refractaire, Paris. *In Japan:* Asahi Glass Co., Tokio.

QUALITY ECONOMY ENDURANCE

CORHART ELECTROCAST REFRACTORIES

THE BULLETIN
OF THE AMERICAN CERAMIC SOCIETY

A Monthly Publication Devoted to Proceedings of the Society and Promotion of Coöperative Research of Technical, Scientific, and Art Questions

VOLUME 16 FEBRUARY, 1937 NUMBER 2

BIBLIOGRAPHY OF CERAMIC MICROSCOPY*

COMPILED BY T. N. MCVAY

Published by the Fellows of the American Ceramic Society

This Bibliography has been compiled in order to provide a list of references to the literature for students and research workers interested in ceramic microscopy and silicate chemistry.

A number of references have been included pertaining to sedimentation, the base exchange of clays, and phase-rule diagrams.

An effort has been made to include all of the important references that are applicable to the subject, but many have possibly been omitted. The writer wishes to be notified of these omissions which, when a sufficient number has been collected, will be published as a supplementary list.

The writer wishes to express his appreciation to the following persons, who through their coöperation have made this Bibliography possible: C. S. Ross, J. L. Gallup, Herbert Insley, A. A. Klein, K. E. Buck, S. M. Phelps, A. B. Peck, C. L. Thompson, R. E. Grim, L. J. Trostel, and G. T. Faust. Thanks are also due Ross C. Purdy, General Secretary of the American Ceramic Society, for permission to quote from *Ceramic Abstracts*

* Received March 29, 1936.

T. N. MCVAY, *University of Alabama*, University, Ala.

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PART II

OUTLINE FOR EXAMINATION OF MINERAL GRAINS

BY K. E. BUCK

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PART I

I. ABRASIVES

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Abrasive products of Canada; technology and application: I, Siliceous abrasives. V. L. EARDLEY-WILMOT. *Can. Dept. Mines Pub.*, No. 673, 119 pp.; **II, Corundum and Diamond.** V. L. EARDLEY-WILMOT. *Ibid.*, No. 675, 51 pp.; *Ceram. Abs.*, **8** [1] 5 (1929).

Artificial corundum; production methods and properties. JOHN G. STEIN & Co. *Refrac. Bull.*, No. 23 (Nov., 1933); abstracted in *Chem. Trade Jour.* [London], **93** [2431] 451 (1933); *Ceram. Abs.*, **13** [5] 120 (1934).

II. ALUMINA MINERALS

Aluminum hydroxides in Arkansas bauxite deposits. D. C. WYSOR. *Econ. Geol.*, **11** [1] 42–50 (1916); *Amer. Mineralogist* (*Abs.*), **1** [6] 101 (1916).—Gibbsite is universally present; secondary bauxite and diaspore are sometimes present.

Composition and properties of diaspore, bauxite, and gibbsite. R. M. HOWE AND R. F. FERGUSON. *Jour. Amer. Ceram. Soc.*, **6** [3] 496–509 (1923).

Study of the shrinkage of diaspore clays: I. S. M. PHELPS. *Jour. Amer. Ceram. Soc.* **9** [10] 659–66 (1926); **II.** *Ibid.*, **15** [2] 96–106 (1932).

Occurrence and properties of crystalline alumina in silicate melts. HELEN BLAIR BARLETT. *Jour. Amer. Ceram. Soc.*, **15** [7] 361–64 (1932).

Zeta-Al_2O_3 identical with gamma-Al_2O_3. D. BELIANKIN.* *Centr. Mineral.Geol.*, **A**, pp. 300–302 (1933); *Ceram. Abs.*, **13** [5] 132 (1934).—The physical constants such as density, n, and a_0 given by Barlett (see preceding reference) for the so-called zeta-Al_2O_3 check those calculated for pure gamma-Al_2O_3. Zeta-Al_2O_3 is not a new form but is merely well-crystallized gamma-Al_2O_3.

Transformation of aluminum oxide from beta to alpha form. JOHN GALLUP. *Jour. Amer. Ceram. Soc.*, **18** [5] 144–48 (1935).—The above is concerned with the change of beta to alpha alumina.

Effect of mineralizers on the formation of sinter corundum. D. S. BELYANKIN AND N. J. FILONENKO. *Compt. rend. acad. sci.* [U.R.S.S.], **2** [2] 146–50 (in German, pp. 150–54 (1935)); *Ceram. Abs.*, **15** [10] 302 (1936).

* Correct spelling Belyankin.

III. ALUMINA-SILICATE MINERALS

Malinite process for production of sillimanite refractories. A. MALINOVSZKY. *Jour. Amer. Ceram. Soc.*, **3** [1] 40–68 (1920).

Note on andalusite from California: A new use and some thermal properties. A. B. PECK. *Amer. Mineralogist*, **9**, 123–29 (1924); *Ceram. Abs.*, **3** [10] 294 (1924).—A commercial deposit of andalusite occurs on White Mt., Inyo Range, Mono Co., Calif. The andalusite rock is coarse granular, compact and gray to light pinkish brown. Coarse crystals occur in cavities, having the forms k (210) and r (101). The material as mined runs 75 to 85% andalusite but, owing to the presence of corundum, chemical analysis shows about 90% Al_2O_3. Associated minerals are lazulite, pyrophyllite, muscovite, deep blue corundum, microscopic inclusions of rutile, and less abundant pyrite, barite, lazurite in quartz veins, and quartz in veins transversing the mass, never in the mass itself. During the firing of the clay-andalusite mixture all of the andalusite is converted into "artificial sillimanite," $3Al_2O_3{\cdot}2SiO_2$ (mullite), with an excess of highly siliceous glass. The inversion occurs at about Seger cone 13. At that temperature the andalusite grains change to groups of paralleled fibrous crystals of "artificial sillimanite" with narrow strips of glass between. Cyanite goes over to interlocking fibers and glass at cone 11.

System alumina-silica. N. L. BOWEN AND J. W. GREIG. *Jour. Amer. Ceram. Soc.*, **7** [4] 238–54 (1924).—A study is given of the equilibrium relations of mixtures of pure alumina and silica at high temperatures (*Errata, ibid.*, [5] 410).

Mullite, a silicate of Al_2O_3. N. L. BOWEN, J. W. GREIG, AND E. G. ZIES. *Jour. Wash. Acad. Sci.*, **14**, 183 (1924); *Ceram. Abs.*, **3** [11] 327 (1924).—Mullite, often thought to be sillimanite, has nearly the same properties. Mullite was synthesized by Deville using SiF_4 on Al_2O_3 and SiO_2 at red heat. It occurs in nature as inclusions of tertiary intrusives in the W. Isles on the Island of Mull, in Scotland, and in Nun's Pass. These have as impurities Fe_2O_3, TiO_2, and alkalis. It also occurs in the crowns of glass pots. The refractive index increases as the TiO_2 and Fe_2O_3 content is raised approaching that of sillimanite. Analyses of rock and glass pot crystals are as follows:

	Rock	Glass Pot
SiO_2	29.04	29.36
Al_2O_3	69.62	69.05
Fe_2O_3	0.50	0.86
MgO		1.12
K_2O	0.18	0.10
Na_2O	0.06	
	99.40	100.49

Preparation (in the electric furnace) of artificial sillimanite for refractory uses. C. E. SIMS, HEWITT WILSON, AND H. C. FISHER. *Trans. Amer. Electrochem. Soc.*, **46**, 513–30 (1924); *Ceram. Abs.*, **4** [1] 16 (1925).—Artificial sillimanite may be prepared by melting materials of the proper proportions of Al_2O_3 and SiO_2 or by melting clay and removing the excess SiO_2 by reduction with C. The SiO_2 is removed partly as Si and partly as SiO_2. Although natural sillimanite has the composition of $Al_2O_3{\cdot}SiO_2$ with an alumina silica ratio of 63:37, artificial sillimanite always has the composition of $3Al_2O_3{\cdot}2SiO_2$, with a ratio of 72:28. Artificial sillimanite of an alumina content below the 3:2 composition crystallizes in long, vitreous needles, but above this ratio it is stony and finely crystallized. As a refractory, the vitreous material is inferior to the stony.

Alleged sillimanite in ceramic products. W. EITEL. *Keram. Rundschau,* **33,** 470 (1924); *Jour. Soc. Glass Tech.,* **9A,** 151 (1925); *Ceram. Abs.,* **5** [7] 231 (1926).

Sillimanite development in some typical clays. HOBART M. KRANER. *Jour. Amer. Ceram. Soc.,* **7** [10] 726–34 (1924).

Changes in constitution and microstructure of andalusite, cyanite, and sillimanite at high temperatures and their significance in industrial practice. A. B. PECK. *Jour. Amer. Ceram. Soc.,* **8** [7] 407–29 (1925); *Amer. Mineralogist,* **10** [9] 253–80 (1925).

Tabulation of the aluminum-silicate minerals. E. T. WHERRY. *Amer. Mineralogist,* **10** [6] 140–45 (1925); *Ceram. Abs.,* **4** [9] 261 (1925).

Dumortierite as a commercial mineral. A. B. PECK. *Amer. Mineralogist,* **11** [4] 96 (1926); *Ceram. Abs.,* **5** [12] 420 (1926).—The location of the Champion mine in Nev., and the occurrence of the mineral dumortierite at this mine are described. The rock, as mined, is composed of minute prismatic needles of dumortierite intimately intergrown with muscovite. The mineral on firing breaks down at a low temperature, beginning at cone 10 or a little lower. The result of this dissociation is the formation of an intimate mixture of mullite crystals in glass. When the breakdown first occurs there is no definite orientation of the mullite crystals with reference to the original dumortierite grains. When the rock is fired it expands as it dissociates, changes in color to a pure white, and takes a dull, porcelain-like luster. Test cones formed from the powdered rock fuse sharply at 1810°C.

Time factor in the formation of some artificial minerals. A. B. PECK. *Jour. Geol.,* **34,** 65–70 ('926); *Ceram. Abs.,* **5** [7] 233 (1926).—The minerals were formed in a Dressler tunnel kiln having a maximum temperature of 1460° after a continuous operation for 18 months. Silica glass was formed at 500 to 600° (98% SiO_2), probably the result of pneumatolytic action owing to an oxidation of the linings composed of SiC. Hematite pseudomorphs after magnetite, in branching arborescent forms were observed, formed at 840°C. Cristobalite lithophysae were noted at a temperature above 1460° produced by the oxidation of SiC. Changes were noted at lower temperatures than usually recorded in the literature, owing to the longer time element. The larger size of crystals also showed a rapidly increasing rate as the temperature increased beyond a certain point. Below this point the time factor seemed negligible.

Formation of mullite from cyanite, andalusite, and sillimanite. J. W. GREIG. *Amer. Jour. Sci.,* [5] **11,** 1–26 (1926); *Ceram. Abs.,* **5** [3] 101 (1926).—The minerals cyanite, andalusite, and sillimanite upon heating are decomposed to mullite and silica or to mullite and siliceous liquid. The silica is probably cristobalite. The lowest temperatures at which these alterations take place are different for the three minerals. Cyanite alters at the lowest temperature, sillimanite at the highest. For all three, there is no definite temperature at which the mineral decomposes sharply to the new phases and below which it remains unaffected for an indefinitely long period. With cyanite and andalusite, the alteration commences on the surfaces of the grains and advances inward. In that of sillimanite the change seems to take place throughout the grain. In all three minerals the rate of decomposition increases rapidly with rise of temperature. When andalusite and sillimanite are decomposed, the newly formed mullite crystals are oriented parallel to the original crystals. With cyanite this orientation is determined by the surfaces from which the mullite grows. The decomposition of cyanite and of andalusite is shown to be accompanied by an absorption of heat. In all three cases, the new phases formed are of lower density than the original mineral, so there is an expansion accompanying the decomposition. Diagrams, tables, and photomicrographs are given.

Thermal dissociation of dumortierite. N. L. BOWEN AND R. W. G. WYCKOFF. *Jour. Wash. Acad. Sci.,* **16** [7] 178–89 (1926); *Ceram. Abs.,* **8** [3] 200 (1929).

Cyanite-clay refractories: I. H. C. HARRISON. *Jour. Amer. Ceram. Soc.,* **9** [5] 257–71 (1926).

Equilibrium considerations of cyanite-clay refractories: II. W. J. MCCAUGHEY AND H. C. HARRISON. *Jour. Amer. Ceram. Soc.,* **9** [5] 271–78 (1926).

New investigations on the system Al_2O_3–SiO_2. WILHELM EITEL. *Ber. deut. keram. Ges.,* **7** [6] 351–53 (1926); *Ceram. Abs.,* **6** [7] 304 (1927).

Study of mullite refractories formed by calcining cyanite; their industrial application. M. L. FREED. *Jour. Amer. Ceram. Soc.,* **9** [5] 249–56 (1926).

Mullite refractories and their industrial application. M. L. FREED. *Fuels & Fur.,* **4** [6] 711 (1926); *Ceram. Abs.,* **5** [9] 279 (1926).

Physical structure of refractory materials. T. S. CURTIS. *Jour. Amer. Ceram. Soc.,* **11** [12] 904–16 (1928).—The article contains a number of photomicrographs in color.

Dumortierite. O. G. GRAWE, J. C. JONES, J. A. CARPENTER, AND W. S. PALMER. *MacKay School of Mines (Univ. of Nev.) Bull.,* No. 2 (1928); *Amer. Mineralogist,* **13** [10] 532 (1928); *Ceram. Abs.,* **8** [1] 63 (1929).—While dumortierite has been reported from seven states, the Humboldt Queen deposit is the only known commercial occurrence. Here it occurs in lenticular masses and in quartz veins; the former originates through the replacement of preëxisting lenses of andalusite formed in an earlier stage in the metamorphism of the rocks.

Cyanite as found in western North Carolina. A. H. FESSLER AND WM. J. MCCAUGHEY. *Jour. Amer. Ceram. Soc.,* **12** [1] 32–36 (1929).

P. B. sillimanite. WILHELM FITZ. *Glastech. Ber.,* **7** [12] 576–81 (1930); *Stahl Eisen,* **50** [17] 559 (1930); *Ceram. Abs.,* **9** [10] 849 (1930).—The occurrence and the mineralogical, chemical, and physical properties of sillimanite are discussed. A comparison with the properties of andalusite and cyanite is made.

Formation of mullite in refractories. P. P. BUDNIKOFF AND B. A. HISCH. *Zhur. Prikladnoĭ Khim.,* **3,** 21–24 (1930); *Ceram. Abs.,* **9** [11] 942 (1930).

Sillimanite kiln refractories made from an andalusite base. FRANK H. RIDDLE AND ROBERT TWELLS. *Jour. Amer. Ceram. Soc.,* **14** [12] 877–83 (1931); *Brick Clay Rec.,* **79** [3] 130–34 (1931); *Ceram. Abs.,* **11** [1] 43 (1932).

Occurrence of andalusite and related minerals at White Mountain, California. P. F. KERR. *Econ. Geol.,* **27** [7] 614–43 (1932); *Ceram. Abs.,* **12** [9] 339 (1933).—The andalusite mine near White Mountain, Calif., contains all

of the commercial ore known at present in the U. S. K. gives a separate description of each of the most significant minerals of the deposit and discusses the relationship of these minerals to each other in following the processes occurring in the formation of the andalusite mass. Petrographic and X-ray diffraction studies of these minerals were made and the results are included in the paper. Illustrated with photographs, sketches, X-ray diffraction patterns, and photomicrographs.

Effect of preparation and calcination treatment on properties of the kaolin-alumina mixtures $Al_2O_3 \cdot SiO_2$. F. H. RIDDLE. *Jour. Amer. Ceram. Soc.*, **15** [11] 583–97 (1932).

Symposium on the physical chemistry of the alumina-silica refractories: I, "Physical chemistry" of a system of refractory components. ROBERT B. SOSMAN. *Jour. Amer. Ceram. Soc.*, **16** [1] 54–57 (1933). **II, The clay minerals.** C. S. ROSS AND P. F. KERR. *Ibid.*, pp. 57–58. **III, Minerals with the composition, $Al_2O_3 \cdot SiO_2$.** HERBERT INSLEY. *Ibid.*, pp. 58–60. **IV, Equilibria in the system, alumina–silica.** ROBERT B. SOSMAN. *Ibid.*, pp. 60–68. **V, Behavior of unstable or monotropic forms in the system alumina–silica, and related systems.** ALBERT B. PECK. *Ibid.*, pp. 68–75. **VI, Kaolins: effect of firing temperature on some of their physical properties.** R. A. HEINDL, W. L. PENDERGAST, AND L. E. MONG. *Ibid.*, pp. 75–76.

Silica–alumina system. ORAZIO REBUFFAT. *Giorn. chim. ind. applicata*, **16** [5] 213–15 (1934); *Ceram. Abs.*, **14** [1] 23 (1935).—R. disagrees with some of the findings of Bowen and Greig.

IV. BOOKS—GENERAL

Elements of Optical Mineralogy: I, Principles and Methods. N. H. WINCHELL AND A. N. WINCHELL. John Wiley & Sons, Inc., New York, 1928. Price $3.50.—This is a thorough treatment of the subject. **II, Description of Minerals.** 2d ed., 1927. xiv + 424 pp., 333 figs. Price $5.50; *Ceram. Abs.*, **7** [6] 411 (1928).—Invaluable to the petrographer. **III, Determinative Tables.** 1929. Colored chart and diagrams in pocket on cover. Price $4.50. *Ibid.*, **9** [6] 469 (1930).—Valuable for thin-section work.

Microscopic Characters of Artificial Minerals. A. N. WINCHELL. 2d ed. John Wiley & Sons, Inc., New York, 1931. xvii + 403 pp.; *Ceram. Abs.*, **11** [5] 323; [8] 468 (1932).—This book gives the optical properties of a large number of artificial minerals.

Microscopic Determination of the Ore Minerals. MAXWELL N. SHORT. *U. S. Geol. Surv. Bull.*, No. 825 (1931). 204 pp., 11 plates, 10 figs. Price 60¢; *Ceram. Abs.*, **10** [10] 730 (1931).

Examination of Fragmental Rocks. FREDERICK G. TICKELL. Stanford Univ. Press, 1931. 122 pp., 35 figs., 2 plates. Price $5.00; *Ceram. Abs.*, **10** [8] 598 (1931).

Textbook of Ore Microscopy (Lehrbuch der Erzmikroskopie): Vol. II. H. SCHNEIDERHOHN AND P. RAMDOHR. Gebruder Borntraeger, Berlin, 1931. Price $17.50. **Appendix: Determinative Tables for Microscopy of Ore Minerals.** 1931. 46 pp.; *Ceram. Abs.*, **11** [5] 323 (1932). **Vol. I, Part I.** 1934. 312 pp., 145 figs. Price (unbound) 24 Rm; *Ceram. Abs.*, **14** [2] 51 (1935).

Thin-Section Mineralogy. A. F. ROGERS AND P. F. KERR. McGraw-Hill Book Co., Inc., New York, 1933. 311 pp. Price $3.00; *Ceram. Abs.*, **13** [3] 71 (1934).

Petrographic Methods for Soil Laboratories. W. H. FRY. *U. S. Dept. Agric. Tech. Bull.*, No. 344 (Jan., 1933). 96 pp. Price 10¢; *Ceram. Abs.*, **15** [1] 41 (1936).—F. gives a clear and concise specific description of the theory and practice of petrography with a bibliography of twenty basic books and papers dealing with petrography and six pages of determinative tables. Many practical hints are included.

Crystals and the Polarizing Microscope (Handbook for Chemists and Others). N. H. HARTSHORNE AND A. STUART. Edward Arnold & Co., London, 1934; Longmans, Green, & Co., Toronto. 272 pp. Price $5.00; *Ceram. Abs.*, **14** [5] 128 (1935).

Crystal Chemistry. O. HASSEL. Translated by R. C. Evans. William Heinemann, Ltd., London, 1935. xi + 94 pp. Price 6s; *Ceram. Abs.*, **15** [8] 260 (1936).

Microscopic Determination of the Non-Opaque Minerals. ESPER S. LARSEN AND HARRY BERMAN. *U. S. Geol. Surv. Bull.*, No. 848. 2d ed., 254 pp. Price 20¢; *Ceram. Abs.*, **13** [7] 196 (1934).

Sedimentary Petrography. H. B. MILNER. D. Van Nostrand Co., New York, 2d ed., 1929. Price $8.50; *Ceram. Abs.*, **9** [6] 469 (1930).—This is an excellent book for use in the study of sediments.

Tables for the Microscopic Identification of Inorganic Salts. W. H. FRY. *U. S. Dept. Agric. Bull.*, No. 1108.

Manual of Petrographic Methods. A. JOHANNSEN. McGraw-Hill Book Co., Inc., New York. Price $7.00.

Data of Geochemistry. F. W. CLARKE. *U. S. Geol. Surv. Bull.*, No. 770. Price $1.00.

Rock Minerals. J. P. IDDINGS. John Wiley & Sons, Inc., New York. (Not listed at present.)

Igneous Rocks: Vol. I. J. P. IDDINGS. John Wiley & Sons, Inc., New York. Price $5.00.

Petrographic Methods. E. H. O. K. WEINSCHENK. McGraw-Hill Book Co., Inc., New York. (Not listed at present.)

Fundamental Principles of Petrology. E. H. O. K. WEINSCHENK. McGraw-Hill Book Co., Inc., New York. (Not listed at present.)

Introductory Text to Optical Mineralogy. T. N. McVAY. University Supply Store, University, Ala., 1933. Mimeographed.

Introduction to Optical Investigation with the Polarizing Microscope. F. RINNE AND M. BEREK. Max Janecke, Leipzig, 1934. viii + 279 pp. Price 11.60 gold marks; *Ceram. Abs.*, **14** [6] 153 (1935).

Determination of the Opaque Minerals. C. M. FARNHAM. McGraw-Hill Book Co., Inc., New York, 1931. 232 pp., illustrated. Price $3.50; *Ceram. Abs.*, **10** [6] 457 (1931).

Microscopic Structure and Concentratability of the Important Iron Ores of the United States. S. R. B. COOKE. *Bur. Mines Bull.*, No. 391 (1936); Price 20¢.—C. gives directions for polishing iron ores and a bibliography on the polishing of ore minerals.

V. CEMENTS

Hydration of Portland cement. A. A. KLEIN AND A. J. PHILLIPS. *Bur. Stand. Tech. Paper*, No. 43, 71 pp. (1914).

Hydraulic properties of the calcium aluminates. P. H. BATES. *Jour. Amer. Ceram. Soc.*, **1** [10] 679–96 (1918).

Lime-silica-iron oxide. H. KÜHL. *Zement*, **10**, 274–76, 361–64 (1921); *Ceram. Abs.*, **1** [12] 338 (1922).

Crystallization and transposition phenomena in the hardening of cement. DR. SCHOTT. *Zement*, **10**, 294–95, 306–308, 328–32 (1921); *Chimie & industrie*, **7**, 322 (1922); *cf. Ceram. Abs.*, **1** [3] 91; [8] 219 (1922).

Cementing qualities of the calcium aluminates. P. H. BATES. *Bur. Stand. Tech. Paper*, No. 197, 27 pp. (1921); *Ceram. Abs.*, **1** [2] 53 (1922).

Action of sodium and magnesium sulfates on Portland cement. G. R. SHELTON. *Ind. Eng. Chem.*, **18** [8] 854–56 (1926); *Ceram. Abs.*, **5** [10] 297 (1926).—The investigation was to determine the difference in sulfate action on Portland cement clinker and on its compounds taken separately. Tests were made on white and commercial Portland cements, using sulfate solutions of various molar concentrations. The reactions of the two cements were different. Reaction products of white cement with sulfates were more like those of the pure cement constituents than were the products formed in the case of commercial cement. The presence of silicates seemed to influence the speed of disintegration of hydrated tricalcium-aluminate crystals since, in the tests with the two varieties of cement and solutions of sodium sulfate, these crystals lasted for a much shorter time than in the tests with pure hydrated tricalcium aluminate. Solutions of magnesium sulfate were especially destructive in their action on crystals of hydrated tricalcium aluminate, regardless of the presence or absence of calcium silicate. The character of the layers surrounding crystals of hydrated lime varied with the sulfate solutions used.

A preliminary petrographic study of Portland cement. J. L. GILLSON AND E. C. WARREN. *Jour. Amer. Ceram. Soc.*, **9** [12] 783–86 (1926).

Mineralogy of several calcium aluminates occurring in alumina-cement clinker. C. W. CARSTENS. *Zement*, **15**, 335–38 (1926); *Ceram. Abs.*, **6** [7] 262 (1927).—The optical constants of $CaO \cdot Al_2O_3$ and $3CaO \cdot 5Al_2O_3$ are given, agreeing with those observed by Rankin and Wright.

Ferro and alumina cements. E. MARTIN. *Mon. Sci.*, **16**, 97–101 (1926); *Chem. & Ind.* **45B**, 586–87 (1926); *Ceram. Abs.*, **5** [10] 297 (1926).—Ferro cements, consisting chiefly of $2Fe_2O_3$, nCaO, where n = 5, 6, or 7 can be obtained by heating lime and pyrites cinder below the fusion temperature. Ferro-aluminous cements are made in a similar way, and their setting and hardening may be varied widely according to the proportion of Fe_2O_3 to Al_2O_3. All of these cements are resistant to attack by sulfates and are suitable for reinforced concrete work in sea-water.

Aluminous cements. G. AGDE AND R. KLEMM. *Z. angew. Chem.*, **39**, 175–86 (1926); *Chem. & Ind.*, **45B**, 275 (1926); *Ceram. Abs.*, **5** [9] 267 (1926).

Studies on the system calcium oxide–ferric oxide–silica. W. C. HANSEN AND R. H. BOGUE. *Jour. Amer. Chem. Soc.*, **48**, 1261–67 (1926); *Ceram. Abs.*, **5** [8] 261 (1926).

Constitution of clinker and composition of the raw mix. ANON. *Zement*, **17**, 329–32; **18**, 353–56 (1927); *Rock Prod.*, **30** [20] 96–97 (1927); *Ceram. Abs.*, **6** [12] 561 (1927).

Studies on the system lime–alumina–silica; the composition, $8CaO + Al_2O_3 + 2SiO_2$. W. C. HANSEN, W. DYCKERHOFF, F. W. ASHTON, AND R. H. BOGUE. *Jour. Phys. Chem.*, **31** [4] 607–15 (1927); *Ceram. Abs.*, **6** [6] 239 (1927).

Petrography and Portland cement manufacture. WM. A. FORBES. *Amer. Iron Steel Inst.* (advance paper, N. Y. Meeting), pp. 30–32 (1927); *Ceram. Abs.*, **7** [3] 137 (1928).

Research on the lime–silica–alumina (Portland cement) system. W. C. HANSEN, W. DYCKERHOFF, F. W. ASHTON, AND R. H. BOGUE. *Rock Prod.*, **30** [8] 64–67 (1927); *Ceram. Abs.*, **6** [7] 305 (1927).

Preparation and optical properties of calcium hydroxide. F. W. ASHTON AND RAYMOND WILSON. *Amer. Jour. Sci.*, [5] **13** [75], 209–18 (1927); *Ceram. Abs.*, **6** [5] 190 (1927).

Studies of the system calcium oxide–alumina–ferric oxide. W. C. HANSEN, L. T. BROWNMILLER, AND R. H. BOGUE. *Jour. Amer. Chem. Soc.*, **52** [2] 396–406 (1928); *Ceram. Abs.*, **7** [4] 256 (1928).

Digest of the literature on the nature of the setting and hardening processes in Portland cement. R. H. BOGUE. (Bur. Standards Fellowship,) reprinted from *Rock Prod.*, **31** [10] 69–70; [12] 62–63; [14] 61–62; [16] 67–70; [18] 65–67; [20] 65–68 (1928); *Ceram. Abs.*, **7** [8] 512; [9] 594; [10] 662; [11] 742; [12] 813 (1928).

Formation and solution of calcium-hydroxide crystals in Portland cement. JASPER O. DRAFFIN. *Ind. Eng. Chem.*, **20** [3] 311 (1928); *Ceram. Abs.*, **7** [7] 425 (1928).

Reaction of water on calcium aluminates. LANSING S. WELLS. *Bur. Stand. Jour. Research*, **1** [6] 951–1009 (1928); R. P. 34; *Ceram. Abs.*, **8** [2] 91 (1929).

Constituents of Portland cement clinker. HANS KÜHL. *Tonind.-Ztg.*, **53** [89] 1571–75 (1929); *Ceram. Abs.*, **9** [3] 155 (1930).—K. reviews existing theories on the composition of the constituents of Portland cement clinker and points out their defects. He explains his own theory and analyses, giving the following compositions: alite = tricalcium silicate + dicalcium aluminate; celite = dicalcium ferrite + dicalcium aluminate. These three materials (tricalcium silicate, dicalcium ferrite, and dicalcium aluminate), appearing in alternate combination as alite and celite, form the ideal Portland cement.

Hydration of the aluminates of calcium: I, A new crystalline form of hydrated tricalcium aluminate. T. THORVALDSON AND N. S. GRACE. *Can. Jour. Research*, **1** [1] 36 (1929); *Ceram. Abs.*, **8** [12] 863 (1929).

Constitution of Portland cement. ANON. *Pit and Quarry*, **17** [8] 91 (1929); *Ceram. Abs.*, **8** [4] 247 (1929).

Constitution of hydrated Portland cement. G. ASSARSSON AND N. SUNDIUS. *Concrete*, **35** [4] 101–104 (1929); *Ceram. Abs.*, **9** [1] 14 (1930).

Hydrates of tricalcium aluminate. W. EITEL. *Zement*, **19** [17] 394–99 (1930); *Chimie & industrie*, **24** [3] 622 (1930); *Ceram. Abs.*, **11** [2] 78 (1932).

Decomposition of tricalcium silicate in the temperature range 1000° to 1300°C. E. T. CARLSON. *Bur. Stand.*

Jour. Research, **7** [5] 893–902 (1931); R. P. 381; *Ceram. Abs.*, **11** [2] 78 (1932).

Studies on the calcium aluminates: I, Crystallization of calcium solutions at 20°C. GUNNAR ASSARSSON. *Z. anorg. allgem. Chem.*, **200** [4] 385–408 (1931); *Ceram. Abs.*, **11** [1] 61 (1932).

Mineralogy of cement. A. C. DAVIS. *Cement & Cement Mfg.*, **4** [12] 1351 (1932); *Ceram. Abs.*, **11** [6] 344 (1932).—The results obtained by X-ray methods, microscopic examinations, and chemical methods support and confirm one another. The collective results defined the major constitution of Portland cement. They indicate (1) that the most abundant constituents are tricalcium silicate and β-dicalcium silicate, (2) that, in addition, there are normally present tricalcium aluminate, tetracalcium alumino-ferrite, and magnesia, and (3) that free lime is not normally present in amounts as great as 2.5%.

Chemical constitution of Portland cement clinker. W. WATSON AND Q. L. CRADDOCK. *Cement & Cement Mfg.*, **7** [2] 54–58; [4] 111–17; [6] 169–77 (1934); *Ceram. Abs.*, **13** [9] 230; [11] 283 (1934).

Constitution of clinkers of Portland cement. B. TAVASCI. *Giorn. chim. ind. applicata*, **16** [11] 538–52 (1934); *Ceram. Abs.*, **14** [4] 87 (1935).

Nature of Portland cement clinker. H. G. FISK. *Jour. Chem. Ed.*, **11** [4] 195–203 (1934); *Ceram. Abs.*, **13** [7] 170 (1934).

Compounds in Portland cement revealed by high-temperature research on cement compounds. R. H. BOGUE. *Ind. Eng. Chem.*, **27** [11] 1312–16 (1935); *Ceram. Abs.*, **15** [6] 173 (1936).

Distribution of compounds in Portland cement. J. ARTHUR SWENSON AND E. P. FLINT. *Jour. Research Nat. Bur. Stand.*, **17** [2] 261–76 (1936); R.P. 910; *Ceram. Abs.*, **15** [11] 323 (1936).

VI. CRYSTALLIZATION PHENOMENA

Crystals and crystal forces. F. E. WRIGHT. *Jour. Wash. Acad. Sci.*, **6**, 326–32 (1916).

Physical chemistry of the crystallization and magmatic differentiation of igneous rocks. J. H. L. VOGT. *Jour. Geol.*, **31** [3] 233–52 (1923); *Ceram. Abs.*, **3** [7] 225 (1924).

Final consolidation phenomena in the crystallization of igneous rock. R. J. COLONY. *Jour. Geol.*, **31** [3] 169–78 (1923); *Ceram. Abs.*, **3** [7] 225 (1924).

Mechanism of crystallization in the solid state. P. I. LEBEDEV. *Reports Don State Univ.* [Rostov-on-Don] **5**, 15–24 (1925); *Mineralog. Abs.*, **3**, 164; *Ceram. Abs.*, **6** [7] 309 (1927).

Theory of crystallization in rock magmas. C. H. DESCH. *Trans. Faraday Soc. (advance proof)* (1924); *Ceram. Abs.*, **5** [2] 68 (1926).

Crystallization. HENRY A. MIERS. *Chem. & Ind.*, **46**, 467 (1927); *Ceram. Abs.*, **6** [9] 404 (1927).

Imperfect crystallization of common things. WILLIAM BRAGG. *Engineering*, **123**, 128–30 (1927); *Ceram. Abs.*, **6** [6] 246 (1927).

VII. ENAMELS

Microscopic examination of opacifiers in enameled ware. ANON. *Keram. Rundschau*, **34**, 67–70 (1926); *Ceram. Abs.*, **5** [5] 143 (1926).—The appearances of enamels under the microscope when opacified with fluorspar and cryolite are described. A continuation of this series by A. OTREMBA is found in *Keram. Rundschau*, **34**, 88–90, 107–109 (1926); *Ceram. Abs.*, **6** [7] 265 (1927).

Microscope in control of vitreous porcelain enamel. J. T. IRWIN. *Enamelist*, **6** [8] 18–28 (1929); *Ceram. Abs.*, **8** [12] 867 (1929).—The many applications of the microscope to enamel-making control and research are discussed. Qualitative microchemical methods for the identification of feldspar, quartz, cryolite, fluorspar, calcspar, zinc, and lead oxides, as well as oxides of nickel, chromium, cobalt, manganese, and iron are given. The determination of free quartz in feldspar is also discussed. The microscope may be advantageously employed in the control of smelting, firing, and general "trouble-shooting." Examples are given and references are included.

Photomicroscopic studies. ANON. *Better Enameling*, **1** [3] 18–24 (1930); *Ceram. Abs.*, **9** [10] 827 (1930).

Optical properties of enamels. L. STUCKERT. *Ceram. Age*, **18** [1] 22–26 (1931); *Ceram. Abs.*, **10** [11] 756 (1931).—The average index of refraction of the glasses upon which enamels are based lies approximately at the value 1.50 to 1.55. The index of refraction is important with reference to the luster and opacity of enamels. The four following types of opacification are found: (1) opacity caused by insoluble components embedded in the batch which have higher exponents of light refraction, (2) devitrification, the separation of single materials from the glass melt, (3) a form based in the nonmiscibility of the components at different temperatures, and (4) that type which results from the presence of a dispersed phase consisting of the most minute gas bubbles in the melt. Opacifiers possess two physical characteristics, *i.e.*, (1) their indices of refraction are either larger or smaller than that of the melt and (2) they have either the lowest possible solubility in the melt when finely divided or those portions which are in solution at higher temperatures separate out as completely as possible on cooling. The nature of gas bubbles, time factor, and opacity of colored enamels are discussed.

Microscopic technique in the investigation of enamel coatings and some observations. G. W. MCGOHAN. *Jour. Amer. Ceram. Soc.*, **15** [7] 389–96 (1932).

Petrographic, metallographic, and X-ray study of enamel-metal contact zones. K. SCHWARTZWALDER AND R. M. KING. *Jour. Amer. Ceram. Soc.*, **15** [9] 483–86 (1932).—Pieces of enamel were removed from contact zones and studied microscopically and with the X-ray and metallographic microscope. A new technique for enamel study is suggested.

Fluoride opacification. WILHELM BÜSSEM AND W. WEYL. *Sprechsaal*, **65** [13] 240–41 (1932); *Ceram. Abs.*, **11** [7] 406 (1932).

Microscope in enamel research and control. ANON.

Amer. Enameler, **7** [8] 3 (1934); *Ceram. Abs.*, **14** [4] 88 (1935).—The application of petrographic and metallographic microscopes to the enameling industry is discussed and examples of their uses are given.

VIII. FELDSPAR

Isomorphism and thermal properties of the feldspars. A. L. Day, E. T. Allen, and J. P. Iddings. *Carnegie Inst. Wash., Geophysical Lab. Bull.* (1905).

Determination of feldspars by means of their refractive indices. Fred E. Wright. *Amer. Jour. Sci.*, [4] **21**, 361–63 (1906).

Graphical plot for use in microscopical determination of the plagioclase feldspars. F. E. Wright. *Amer. Jour. Sci.*, [4] **36**, 540–42 (1913).

Mineralography of the feldspars: I. Harold L. Alling. *Jour. Geol.*, **29** [3] 193–295 (1921); abstracted in *Jour. Amer. Ceram. Soc.*, **4** [12] 1007 (1921).—This is an extensive and thorough summary and development of the collected knowledge of the physical chemistry of this group of minerals. **II.** *Ibid.*, **31** [4] 282–305; [5] 353–75 (1923).—This is an extension of the considerations of Part I with additional material. Illustrated with phase-rule diagrams and with 18 additional photomicrographs.

Specific gravity and refraction of the potash-soda-feldspars. D. Byelvankin.* *Bull. Petrograd. Polytech. Inst.*, **24**, 437–52 (1915); *Mineralog. Abs.*, **1**, 89–90; *Ceram. Abs.*, **1** [12] 309 (1922).

Polarizing microscope as an aid in feldspar standardization. Howard C. Arnold. *Jour. Amer. Ceram. Soc.*, **6** [2] 409–13 (1923).

Studies in the feldspar group. A. N. Winchell. *Jour. Geol.*, **33**, 714–27 (1925); *Ceram. Abs.*, **5** [5] 167 (1926).—A discussion of the relations between optic properties and composition in the apparently continuous series $KAlSi_3O_8$–$NaAlSi_3O_8$ and $KAlSi_3O_8$–$BaAl_2Si_2O_8$, with notes on the classification of the plagioclases.

Behavior of feldspars at high temperatures. E. Dittler and A. Köhler. *Anz. Akad. Wiss. Wien.*, **61**, 153–54 (1924); *Ceram. Abs.*, **5** [7] 233 (1926).

Potash-soda feldspars. Harold L. Alling. *Jour. Geol.*, **34**, 591–611 (1926); *Ceram. Abs.*, **6** [3] 114 (1927).

Determination of plagioclase feldspars. R. W. Goranson. (Contributions from Dept. of Mineralogy and Petrography, Harvard Univ., No. 10.) *Amer. Mineralogist*, **11** [6] 139–54 (1926).

Microphotographic study of free quartz in feldspar. A. Malinovszky. *Jour. Amer. Ceram. Soc.*, **10** [1] 23–29 (1927).

Perfect new ways to analyze feldspar. Anon. *Ceram. Ind.*, **9** [4] 390 (1927); *Ceram. Abs.*, **6** [12] 592 (1927).—A description is given of the interferometer method for determining thermal expansion of materials as used by the Bureau of Standards.

Quantitative microscopic analysis of commercial feldspar. Herbert Insley. *Jour. Amer. Ceram. Soc.*, **10** [9] 651–69 (1927).—This investigation was undertaken to develop microscopic methods for determining quantitatively the mineral constituents in feldspars used in the ceramic and allied industries. After several methods had been tried, a method of counting the grains and of using liquids of different indices of refraction for distinguishing the constituents was finally adopted. Nineteen commercial feldspars were analyzed by this method and the results were compared with the results obtained by computing the chemical analyses to mineral constituents. Another method in which a partially fused sample was examined microscopically was also found suitable. It is concluded that, while neither the counting method nor the fusion method is as accurate as chemical analysis, the counting method gives satisfactory results for plant control in terms of potash feldspar, plagioclase feldspar, and quartz, when used by a skilled microscopist, and that the fusion method gives satisfactory results in the hands of the plant technologist for estimating quartz.

Chemical control of feldspars. F. P. Knight, Jr. *Jour. Amer. Ceram. Soc.*, **11** [7] 560–70 (1928).—A definition of feldspar is given and the minerals in feldspars are enumerated. The importance of chemical control, method of analysis, and the calculation of mineral composition from chemical analysis and its value are presented. In explaining mechanical control procedures, the method of sampling, storage, and mixing of feldspars, the fusion and block tests, reasons for the nonuniformity in fusions, and free quartz determinations are described and discussed.

Indices of refraction of plagioclase feldspars. Harold L. Alling. *Jour. Geol.*, **37**, 462–82 (1929); *Ceram. Abs.*, **9** [5] 379 (1930).

New synthetic investigations in the feldspar group. Emil Dittler and Hans Lasch. *Sitz. ber. Akad. Wiss. Wien. Math. naturw. Klasse., Abt. I*, **140** [8] 633–74 (1931); *Ceram. Abs.*, **11** [11] 590 (1932).

Investigation of properties of some feldspars. C. W. Parmelee and T. N. McVay. *Univ. Ill. Eng. Expt. Sta. Bull.*, No. 233 (1931); *Ceram. Abs.*, **11** [6] 376; [9] 501 (1932).

Permanent changes in the optic orientation of feldspars exposed to heat. Tom F. W. Barth. *Norsk. Geol. Tids.*, **12**, 57–72 (1932); *Ceram. Abs.*, **11** [8] 470 (1932).

Perthites. Harold L. Alling. *Amer. Mineralogist*, **17** [2] 43–65 (1932).

Quantitative microscopic determination of the quartz content of commercial ground feldspars. C. L. Thompson. *Jour. Amer. Ceram. Soc.*, **17** [8] 257–58 (1934).

Rapid method for determination of plagioclase by the Fedorov universal stage. T. J. Ho. *Amer. Mineralogist*, **20** [11] 790–98 (1935); *Ceram. Abs.*, **15** [4] 134 (1936).

Peculiar type of zoning in feldspar. J. M. Trefethen. *Amer. Mineralogist*, **21** [5] 327–29 (1936); *Ceram. Abs.*, **15** [9] 285 (1936).

* Correct spelling Belyankin.

IX. GYPSUM PRODUCTS

Hydration of anhydrite and dead-burned gypsum. A. C. GILL. *Jour. Amer. Ceram. Soc.*, **1** [1] 65–71 (1918). —Study of anhydrite over a period of time.

Microscopic examination of raw and calcined gypsum. E. S. LARSEN. *Proc. A.S.T.M.*, **23** [Part I] 236–43 (1923); *Ceram. Abs.*, **3** [9] 259 (1924).—A microscopic description including form of crystal, *n*, etc., is given for the minerals most commonly found in raw gypsum, *viz.*, gypsum, quartz, anhydrite, calcite, and clay. The changes which occur in these constituents during calcination are discussed and the $CaSO_4 \cdot {}^1/_2H_2O$ formed is described microscopically. A method for the estimation of anhydrite is given.

Energy of crystallization of burned gypsum. M. VON GLASENAPP. *Z. anorg. allgem. Chem.*, **130,** 246–52 (1923); *Ceram. Abs.*, **3** [4] 96 (1924).—The setting of gypsum is due to recrystallization as the dihydrate, following the solution of the hemihydrate. The resulting change in structure is illustrated by photomicrographs of the original and regenerated gypsum; the latter is composed of much finer crystals and is harder and more porous. Setting in water-vapor only produces similar effects with even finer crystals (*cf.*, *Ceram. Abs.*, **2** [11] 239 (1923)).

Notes on the chemical and microscopic determinations of gypsum and anhydrite. H. F. GARDNER. *Proc. A.S.T.M.*, **26** [Part 1] 296–301 (1926); *Ceram. Abs.*, **6** [5] 165 (1927).—A discussion is presented tending to show the possible inaccuracies in the present methods of chemical and petrographic analyses of gypsum and anhydrite.

Hard-finish gypsum plasters. T. N. MCVAY. *Univ. Ill. Eng. Expt. Sta. Bull.*, No. 163, pp. 5–43 (1927); *Ceram. Abs.*, **7** [1] 11 (1928).

Hardening of plaster of Paris and the existence of soluble anhydrite. P. P. BUDNIKOFF. *Kolloid Z.*, **42,** 149–54 (1927); *Ceram. Abs.*, **7** [6] 346 (1928).

Crystal forms of calcium sulfate. L. S. RAMSDELL AND E. P. PARTRIDGE. *Amer. Mineralogist,* **14** [2] 59–73 (1929); *Ceram. Abs.*, **8** [5] 366 (1929).

Setting of plaster of Paris. H. B. WEISER AND F. B. MORELAND. *Jour. Phys. Chem.*, **36** [1] 1–30 (1932); *Ceram. Abs.*, **11** [5] 291 (1932).

X. GLASS

(1) Devitrification

Tridymite crystals in glass. N. L. BOWEN. *Amer. Mineralogist,* **4** [6] 65–66 (1919).

Devitrification of glass. N. L. BOWEN. *Jour. Amer. Ceram. Soc.*, **2** [4] 261–81 (1919).

Devitrification of glass. H. W. CRAVER. *Diamant,* **42,** 379; *Glass Ind.*, **1,** 40 (1920); *Ceram. Abs.*, **1** [3] 79 (1922).

Investigation of the glassy state by the method of inforced crystallization. J. F. PONOMAREFF. *Jour. Soc. Glass Tech.*, **11** [41] 39–52 (1927); *Ceram. Abs.*, **6** [9] 375 (1927).

Devitrification phenomena. V. GROSSMANN. *Keram. Rundschau,* **37** [21] 361–64 (1929); *Glass. Ind.*, **10** [8] 195 (1929); *Ceram. Abs.*, **8** [10] 714 (1929).

Devitrification of glass: (1) relative stabilities of different glasses; (2) time-temperature curves of visible devitrification; (3) proposed classification of glasses. C. W. PARMELEE AND A. J. MONACK. *Jour. Soc. Glass Tech.*, **13** [52] 322–36 (1929); *Ceram. Abs.*, **9** [7] 512 (1930).

Crystal modes of technical calcium-sodium silicate devitrification and their interpretation. HANS JEBSEN-MARWEDEL. *Sprechsaal,* **62,** 715–17, 735–39, 753–56, 773–76, 791–93 (1929); *Ceram. Abs.*, **10** [8] 552 (1931).

Effect of alumina on devitrification of a soda-lime-silica glass. GEORGE W. MOREY. *Jour. Amer. Ceram. Soc.*, **13** [10] 718–24 (1930).—The effect of Al_2O_3 on the devitrification temperature of a soda-lime-silica glass approximately of the composition $Na_2O \cdot CaO \cdot 6SiO_2$ has been studied in two series of experiments. In one of these, CaO was partially replaced by Al_2O_3 until the final glass had the composition of the mineral albite, $Na_2O \cdot Al_2O_3 \cdot 6SiO_2$. In this series of experiments the melting point of the glass was first lowered until the glass passed from the tridymite into the $Na_2O \cdot 3CaO \cdot 6SiO_2$ field; it then rose slightly to a maximum, fell until the glass entered the field of $CaO \cdot SiO_2$, and then rose rapidly until the field of albite was reached. Glasses near albite in composition are practically impossible to crystallize in the dry way. In the second series of experiments, Al_2O_3 was added to the same glass, and it was found that the fields of tridymite and $Na_2O \cdot 3CaO \cdot 6SiO_2$ were quickly passed through, with a smaller lowering of melting point than in the preceding series, after which the melting point rapidly increased with $CaO \cdot SiO_2$ as the primary phase. No generalization can be made as to the effect of alumina on the devitrification of soda-lime glass. The problem is one of the freezing-point relations in a 4-component system and, in the absence of definite knowledge of the liquidus temperatures and corresponding stability regions in that 4-component system, general statements would probably be misleading. In addition, the devitrification of some 5-component soda-lime glasses containing both Al_2O_3 and MgO is discussed.

Crystallization relations in soda-lime-silica glasses. G. W. MOREY. (Paper presented but not published.) *Ceram. Abs.*, **9** [3] 168 (1930).

Effect of magnesia on the devitrification of a soda-lime-silica glass. GEORGE W. MOREY. *Jour. Amer. Ceram. Soc.*, **13** [10] 714–17 (1930).

Devitrification of soda-lime-silica glasses. GEORGE W. MOREY. *Jour. Amer. Ceram. Soc.*, **13** [10] 683–713 (1930).—The isotherms and boundary curves in that portion of the ternary system $Na_2O \cdot SiO_2$–$CaO \cdot SiO_2$–SiO_2 of direct application to glass technology, *viz.*, from 64 to 78% SiO_2, 0 to 20% CaO, including the whole of the field of the compound $Na_2O \cdot 3CaO \cdot 6SiO_2$, and portions of the adjoining fields of $Na_2O \cdot 2SiO_2$, $Na_2O \cdot 2CaO \cdot 3SiO_2$, $CaO \cdot SiO_2$, tridymite, and quartz have been determined with greater precision than in a previous study by greatly increasing the number of mixtures studied and thereby decreasing the interpolation necessary in the interpretation.

An extended discussion is given of the devitrification of glass, in which it is shown that the liquidus temperature is the only datum point which is solely a function of glass composition and is unaffected by the past history of the glass or by fortuitous circumstances at the time devitrification is taking place.

Devitrification of "Pyrex" glasses. G. W. MOREY. *Jour. Amer. Ceram. Soc.*, **14** [7] 529–31 (1931).—A study has been made of the devitrification phenomena of three Pyrex-brand glasses which were found to have liquidus temperatures lower than any other known mixtures containing so high a silica content. Pyrex-brand glass 774 (702EJ), refractive index 1.471, has a liquidus temperature of 1077°; 772 (702P) index 1.485, 1042°; and 776 (720-GO), index 1.473, 1036°. In all cases tridymite is the primary phase and cristobalite was never observed.

Devitrification. F. W. PRESTON. *Glass Ind.*, **12** [1] 1–3 (1931); *Ceram. Abs.*, **10** [4] 259 (1931).

Identification of devitrification products of the soda-lime-silica technical glasses. A. DIETZEL. *Glastech. Ber.*, **9** [5] 307–309 (1931); *Ceramics & Glass*, **7** [9] 47 (1931); *Ceram. Abs.*, **11** [7] 407 (1932).

Influence of alumina on the constants of devitrification of soda-lime-silicate glasses. W. MÜLLENSIEFEN AND E. ZSCHIMMER. *Glastech. Ber.*, **9** [5] 280–307 (1931); *Ceramics & Glass*, **7** [9] 54; [10] 10 (1931); *Ceram. Abs.*, **11** [7] 405 (1932).

X-ray studies of crystalline substances in glasses. VICTOR HICKS. *Jour. Amer. Ceram. Soc.*, **19** [5] 148–52 (1936).

Devitrification phenomena caused by improper melting. E. FELSNER. *Keram. Rundschau*, **43** [5] 52 (1935); *Ceram. Abs.*, **15** [6] 175 (1936).

Effect of alumina on the devitrification of some soda-lime glasses. WILLIAM HORAK AND D. E. SHARP. *Glass. Ind.*, **17** [5] 162–64 (1936); *Ceram. Abs.*, **15** [7] 202 (1936).

(2) Miscellaneous

Relation between refractive index and the density of some crystallized silicates and their glasses. E. S. LARSEN. *Amer. Jour. Sci.*, [4] **28**, 263–74 (1909).

Development of various types of glasses: XII, Interaction of silica, sodium oxide, and barium oxide. C. J. PEDDLE. *Jour. Soc. Glass Tech.*, **5**, 201–11 (1921). **XIII, Interaction of silica, potassium oxide, and barium oxide.** C. J. PEDDLE. *Ibid.*, pp. 212–20. **XIV, Interaction of silica, barium oxide, and the oxides of sodium and potassium.** C. J. PEDDLE. *Ibid.*, pp. 220–28. **XV, Comparison of the alkali-barium oxide-silica glasses.** C. J. PEDDLE. *Ibid.*, pp. 228–56.—A long series of soda-barium, potash-barium, and soda-potash-barium silicates were studied. Statistics are given in regard to effect of composition on color, density, refractive index, dispersion, devitrification, form of crystals, solubility, durability, and pot attack, and some general conclusions are drawn. **XVI, A comparison of the alkali-barium silicate and alkali-lead silicate glasses.** C. J. PEDDLE. *Ibid.*, pp. 256–68; *Ceram. Abs.*, **1** [6] 165–66 (1922).

Manufacture of optical glass. C. J. PEDDLE. *Trans. Opt. Soc.* [London], **23**, 2 (1921–1922); *ibid.*, p. 103; *Ceram. Abs.*, **1**, [4] 111 (1922); *ibid.*, **3** [1] 6 (1924).

Relation between optical constants and composition of glass: I, Soda-lime glass. A. TAKAMATSU. *Report Osaka Ind. Research Lab.* [Japan], **6** [9] 1–36 (1925); *Ceram. Abs.*, **5** [10] 306 (1926).—Sixty different soda-lime glasses were prepared and their optical constants were determined by Pulfrich's refractometer. As sources of light, Na light was used for $D(0.5893\mu)$, Geissler tubes (containing H_2) for C $(0.6563\ \mu)$ $F(0.4862\mu)$. The detailed results are given in 23 tables and 9 curves. The optical constants of glass undergo changes regularly with the composition of the glass.

Decomposition of glass by water at high temperatures. G. W. MOREY AND N. L. BOWEN. *Jour. Soc. Glass Tech.*, **11** [42] 97–106 (1927); *Ceram. Abs.*, **6** [10] 428 (1927).

Opal glass. J. F. HYSLOP. *Jour. Soc. Glass Tech.*, **11** [44] 362–74 (1927); *Ceram. Abs.*, **7** [5] 283 (1928).

Glassy state of matter. P. P. LASAREFF. *Ceramics & Glass*, No. 6, pp. 136–38 (1928); *Ceram. Abs.*, **8** [1] 28 (1929).

Microscopical examination of glass. L. SPRINGER. *Glass*, **6** [9] 386–89 (1929); *Ceram. Abs.*, **8** [12] 872 (1929).

Index of refraction *vs.* composition of soda-lime glasses. ANON. *Bur. Stand. Tech. News Bull.*, No. 155, p. 26 (1930); *Ceram. Abs.*, **9** [6] 418 (1930).

Index of refraction of some soda-lime-silica glasses as a function of their composition. C. A. FAICK AND A. N. FINN. *Jour. Amer. Ceram. Soc.*, **14** [7] 518–28 (1931); *Bur. Stand. Jour. Research*, **6** [6] 993–1002 (1931); R.P. 320.

Particle size and concentration in opal glass. E. H. RAYNER. *Rept. Nat. Phys. Lab.* [London], pp. 147–48 (1932); *Ceram. Abs.*, **12** [12] 418 (1933).

Particle size and concentration in opal-diffusing glasses. C. DUNBAR. *Jour. Soc. Glass Tech.*, **17** [68] 411–32 (1933); *Ceram. Abs.*, **13** [5] 113 (1934).—The average particle size and concentration in a number of opal glasses were determined by means of a high-power microscope, and the way in which these quantities vary through the thickness of a glass was investigated. The diffusing properties of the glasses were measured photometrically and the average size and concentration of the particles in the glasses were deduced from the theoretical equations of RYDE and COOPER (*Ceram. Abs.*, **12** [7] 256 (1933)). A comparison has been made of the theoretical and experimental results, and it is shown that over the range of particle size considered the theory is in good agreement with experiments. (See also *ibid.*, **12** [4] 147 (1933)).

Crystallization of pigments in selenium ruby. A. N. DAUVALTER. *Keram. i Steklo*, **11** [5] 30–34 (1935); *Ceram. Abs.*, **14** [11] 272 (1935).

(3) Stones

Identification of "stones" in glass. N. L. BOWEN. *Jour. Amer. Ceram. Soc.*, **1** [9] 594–605 (1918).—This is an important paper on the subject.

Study of the origin and cause of stones in glass. HERBERT INSLEY. *Jour. Amer. Ceram. Soc.*, **6** [6] 706–16 (1923).

Microscopic identification of stones in glass. HERBERT INSLEY. *Jour. Amer. Ceram. Soc.*, **7** [1] 14–18 (1924).—Methods are given for the identification of stones by the use of immersed grains and of thin sections for studying

structure. A list of minerals found as stones and their distinguishing characteristics are presented.

A new glass stone: $Na_2O{\cdot}3CaO{\cdot}6SiO_2$. ALBERT B. PECK. *Jour. Amer. Ceram. Soc.*, **9** [6] 351–53 (1926).—Attention is called to a stone of different composition from any heretofore recorded and but recently possible of identification by petrographic-microscopic means through the work by Bowen and Morey on the system Na_2SiO_3–$CaSiO_3$–SiO_2.

Determination of the source and means of prevention of stones in glass. HERBERT INSLEY. *Jour. Amer. Ceram. Soc.*, **12** [3] 143–52 (1929).—The microscopic characteristics of different crystalline materials occurring as stones or lumps in glass are described and photomicrographs of stones originating from devitrification of the glass, incomplete solution of batch constituents, and incorporation in the glass of refractory wall material are reported. Methods of determining the location in the glass-making system of the source of stones, using microscopic as well as other methods, are given. Means of prevention or elimination of the stones are suggested.

Stony glass. L. SPRINGER. *Sprechsaal*, **63** [25] 464–66; [26] 484–86 (1930); *Ceram. Abs.*, **9** [9] 725 (1930).

Stones in glass and devitrification. A. GRANGER. *Céram. Verrerie Émail.*, **1** [8] 389–92 (1933); **2** [1] 5–6; [2] 53–54; [3] 101–108; [4] 149–54 (1934); *Ceram. Abs.*, **13** [10] 256 (1934).

Stones—whence do they come? ANON. *Glass Ind.*, **16** [1] 13–14 (1935); *Ceram. Abs.*, **14** [3] 67 (1935).—By use of a petrographic microscope most minerals can be almost definitely identified without chemical assistance. In identifying stones in glass, some history of the stones, such as the batch composition, furnace temperature, refractories used, and any other available information, is of value to the investigator. Most batch stones are found to be silica undergoing solution. These are usually eliminated by more thorough batch mixing, changes in temperature distribution in the furnace, or a slower draw. The compound, $Na_2O{\cdot}3CaO{\cdot}6SiO_2$, is the principal mineral which would crystallize from most common soda-lime glasses. Should the mineral appear as a stone it is likely that, owing to poor circulation, variations in glass level, or some such irregularity, glass in some part of the furnace is being heat-treated at temperatures around 2000°F to permit crystallization to take place, and pieces of recrystallized material are breaking from the furnace. Tridymite and cristobalite are sometimes found nicely crystallized but it is difficult to say if they are recrystallized from solution, if they are spalls from the refractory, or if they are batch stones of silica which have inverted from quartz. Nephelite ($Na_2O{\cdot}Al_2O_3{\cdot}2SiO_2$) has been found as a recrystallization product. Refractories frequently cause stones by their extreme insolubility or by their poor bond. Corundum as a stone may come from clay converted to mullite, the mullite breaking down in the presence of alkalis, from cements used as mortars, or from poorly bonded refractory itself. Clay refractories allow sufficient glass penetration to develop a layer of nephelite on their surface and slightly beyond.

Determining stones in glasses. M. A. BESBORODOV. *Keram. i Steklo*, **11** [12] 27–36 (1935); *Ceram. Abs.*, **15** [6] 175 (1936).

Identification of stones in glass. C. L. THOMPSON. *Glass Ind.*, **17** [7] 236 (1936); *Ceram. Abs.*, **15** [9] 272 (1936).

XI. GLAZES

Studies in glazes: I, Fritted glazes. R. C. PURDY AND H. B. FOX. *Trans. Amer. Ceram. Soc.*, **9**, 95–186 (1907). **II, Crystalline glazes.** R. C. PURDY AND J. F. KREHBIEL. *Ibid.*, pp. 319–407.

Some phenomena in glaze reduction. H. B. HENDERSON. *Jour. Amer. Ceram. Soc.*, **1** [3] 148–59 (1918).—The microstructure of sewer-pipe glazes is discussed.

Microscopic study of stresses in glazes. ARTHUR V. HENRY. *Jour. Amer. Ceram. Soc.*, **8** [2] 117–21 (1925).

Salt glaze in thin section. W. FISCHER. *Keram. Rundschau*, **36**, 165–67 (1928); *Ceram. Abs.*, **7** [8] 537 (1928).—A microscopic study of thin sections of salt-glazed ware, the thin section being cut normal to the glaze-body contact shows (1) the more densely fired the body, the sharper the boundary between glaze and body, (2) the thickness of a normal salt glaze is 0.01 to 0.05 mm., (3) the longer the period of salting the greater the thickness of the glaze, although the increase in glaze thickness is greater in the early periods, (4) the salt glaze is heterogeneous and tends to crystallize, and (5) the thicker the glaze the greater the crystallization tendency. Imperfect (foamy or silvery) salt glazes are characterized by glaze thickness and by octahedral crystals arranged in bands or cords and often as skeleton forms which are probably composed of Fe_2O_3 (with dissolved FeO) and ilmenite.

Salt glaze. BERNHARD NEUMANN. *Sprechsaal*, **62** [36] 653–55; [37] 673–76 (1929); *Ceram. Abs.*, **8** [12] 899 (1929).

Microstructure of some porcelain glazes. CLYDE L. THOMPSON. *Univ. Ill. Eng. Expt. Sta. Bull.*, No. 285; *Ceram. Ind.*, **16** [5] 542 (1931); *Ceram. Abs.*, **10** [6] 463; [7] 524 (1931).—The composition of both the glazes and glaze glasses investigated fall within the range $\left.\begin{matrix}0.3\ K_2O\\0.7\ CaO\end{matrix}\right\}$ 0.3 to 1.0 Al_2O_3, 2.0 to 8.0 SiO_2. A great amount of material present is undissolved and recrystallizes at cone 12. Most good bright glazes contain undissolved quartz and many have traces of crystallization, either of anorthite or tridymite. Only four were entirely glassy. All good mat glazes except one fall within the anorthite area. They consist of a glassy matrix in which are suspended numerous small needle-like crystals, which are simple twins of anorthite, though multiple twinning is observed in some cases. Many semimat glazes contain anorthite in approximately the same amount and crystal size, but the mat texture is spoiled by the undissolved quartz, each grain of which is surrounded by clear glass, which seems to give slight gloss to the glaze thus spoiling the good mat texture. This is a possible explanation for the change of a semimat into a mat glaze on increasing the temperature by the solution of the quartz. Corundum, anorthite, leucite, and pseudo-wollastonite separate as

primary phases. T. concludes that (1) good mat glazes within the porcelain glaze field owe their matness to crystallization. (2) Alumina plays a double rôle in the development of mat glazes by furnishing an essential constituent of the crystallizing mineral and by so regulating the viscosity of the glaze that the crystals do not grow to a sufficient size to spoil the mat texture. (3) Many bright porcelain glazes are not all glass but contain undissolved quartz and have traces of devitrification. (4) An excess either of alumina or silica will cause devitrification, while a greater excess will cause immaturity.

Crystal glazes: I–II. J. WOLF. *Sprechsaal,* **64** [20] 371–74; [21] 391–93 (1931); *Ceram. Abs.,* **10** [9] 621 (1931).

Microstructure of electrical porcelain glazes. HOBART M. KRANER. *Ceram. Ind.,* **21** [2] 73–75 (1933); *Ceram. Abs.,* **12** [10–11] 382 (1933).—It has been found that different standard glazes used for electrical porcelain cause variations of as much as 50% of the tensile strength of the porcelain in tension. A microscopic study of a number of different glazes showed that in many there are cloudy appearances representing extremely fine undissolved particles which give opacity and color, in others there are large particles of quartz, while in others there are large bubbles representing the evolution of absorbed gases from the batch during melting. The glazes consisting largely of Albany slip generally show less undissolved material, bubbles, and evidence of recrystallization than other glazes. Photomicrographs show that many of the commercial glazes are not glasses as they are ordinarily considered, and the so-called mahogany Albany slip glazes seem to be the nearest approach to a perfect glossy coating that is available.

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Microstructure of some porcelain glazes: I. S. KONDO AND T. L. TONG. *Jour. Jap. Ceram. Assn.,* **42,** 539 (1934); *Ceram. Abs.,* **14** [6] 144 (1935).

Microstructure of mat lead glazes. C. W. PARMELEE AND WILLIAM HORAK. *Jour. Amer. Ceram. Soc.,* **17** [3] 67–72 (1934).

XII. MISCELLANEOUS

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Hematite and rutile formed by the action of chlorine at high temperatures. H. E. MERWIN AND J. C. HOSTETTER. *Amer. Mineralogist,* **4** [10] 126–27 (1919).

Zirconia as a refractory. E. H. RODD. *Jour. Soc. Chem. Ind.,* **37,** 213–15 (1918); *Amer. Mineralogist,* **4** [8] 104 (1919).

Microscopic structure of common brick. SEIJI KONDO. *Jour. Jap. Ceram. Assn.,* No. 370, pp. 283–91 (1923); *Ceram. Abs.,* **2** [11] 253 (1923).—Structure of common brick manufactured at the two biggest plants in Tokyo and Osaka districts is reported.

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Asbestos fibers. J. N. LONGLEY. *Chem. & Ind.,* **46,** 525–26 (1927); *Ceram. Abs.,* **6** [9] 403 (1927).

Optical properties and the changes in the state of zircon. W. F. EPPLER. *Z. Krist.,* **64,** 510–11; *Physik. Ber.,* **8,** 734 (1927); *Ceram. Abs.,* **7** [12] 840 (1928).

Some factors influencing the thermal properties of minerals and products of the ceramic industry. W. M. COHN. *Jour. Amer. Ceram. Soc.,* **11** [5] 296–306 (1928).

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of small needle crystals radiating from a common center. Measurable properties of the spherulites are listed and a simple explanation of the behavior of spherulites is given. A partial list of measured optical data covering 67 substances in the spherulitic form is appended; 20 fine photomicrographs.

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XIII. PETROGRAPHIC METHODS

(1) Apparatus

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Rayner pocket refractometer. Ward's Natural Science Establishment. 102 Goodman St., N. Rochester, N. Y. *Ward's Mineral Bull.*, No. 5, 5 pp. (Jan., 1937).

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Modified universal stage: III. R. C. EMMONS. *Amer. Mineralogist*, **14** [12] 441–61 (1929); *Ceram. Abs.*, **9** [3] 217 (1930).

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Objective with a variable diaphragm. CHESTER B. SLAWSON. *Amer. Mineralogist*, **19** [1] 24–28 (1934).

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Grain-size measuring (microscope) eyepiece. BAUSCH & LOMB OPTICAL CO. *Instruments*, **8** [11] 312 (1935); *Ceram. Abs.*, **15** [3] 99 (1936).

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Microscopic investigations of raw materials and products. ANON. *Keramos*, **7** [7] T6 (1928); *Ceram. Abs.*, **7** [6] 640 (1928).

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(3) Immersion Media

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Immersion melts of high refraction. T. F. W. BARTH. *Amer. Mineralogist*, **14** [10] 358–61 (1929); *Ceram. Abs.*, **9** [1] 65 (1930).—The indices of refraction of mixed crystals of thallium bromide and thallium iodide are given; indices above 2.6 may be obtained.

Set of thirty immersion media. R. C. EMMONS. *Amer. Mineralogist*, **14** [12] 482–83 (1929); *Ceram. Abs.*, **9** [3] 231 (1930).

Preparation and purification of the tri-iodides of antimony and arsenic for use in immersion media of high refractive index. H. G. FISK. *Amer. Mineralogist*, **15** [7] 263–66 (1930).

Immersion liquids of low refraction. V. F. HARRINGTON AND M. J. BUERGER. *Amer. Mineralogist*, **16** [2] 45–54 (1931); *Ceram. Abs.*, **10** [5] 390 (1931).—Fractioning and determining the indices of the lower petroleum distillates gives a series of ideal immersion media with indices lower than 1.45. They are stable, do not dissolve inorganic compounds, and may be obtained with almost any index without mixing. The index is constant on evaporation. The commercial distillates used were petroleum ether, two ligroins gasolene, and kerosene. Tables and graphs indicate concisely the results obtained.

Piperine as an immersion medium in sedimentary petrography. J. H. C. MARTENS. *Amer. Mineralogist*, **17** [5] 198–99 (1932).—Advantages are made of the refractive index (1.68) and strong dispersion of piperine in mineral analyses.

Immersion liquids of intermediate refraction (1.450–1.630). ROBERT D. BUTLER. *Amer. Mineralogist*, **18** [9] 386–401 (1933).

Optical properties of ideal solution immersion liquids. M. J. BUERGER. *Amer. Mineralogist*, **18** [8] 325–34 (1933).

Recent developments in high index resin. A. E. ALEXANDER. *Amer. Mineralogist*, **19** [8] 385 (1934).

Notes on the synthetic resin Hyrax. EUGENE N. CAMERON. *Amer. Mineralogist*, **19** [8] 375–83 (1934).

Mounting medium of 1.66 index of refraction. W. D. KELLER. *Amer. Mineralogist*, **19** [8] 384 (1934).—Arochlor. No. 4456 (Monsanto Chemical Co., Birmingham, Ala.), 40¢ per lb.

Liquids of high refractive index. B. W. ANDERSON AND C. J. PAYNE. *Nature*, **133** [3350] 66–67 (1934); *Ceram. Abs.*, **13** [7] 193 (1934).—Immersion media of indices above that of sulfur in methylene iodide ($N_D < 1.79$) are listed for use in determining the refractive indices of crystals whose index exceeds 1.79. Tetraiodoethylene, C_2I_4, dissolves in methylene iodide (22% at 15°C) and with sulfur in this liquid forms a clear, stable solution, $N_D = 1.81$, adapted for routine use with the refractometer. Phenyldi-iodoarsine, $C_6H_5AsI_2$, is a clear orange liquid, $D^{15°} = 2.56$, with a high refractive index and dispersion as shown:

λ (*A*)	6708	6438	6141	5893	5535	5350	5106
$N^{15°}$	1.822	1.828	1.835	1.843	1.856	1.865	1.879

Phenyldi-iodoarsine has a blistering action on the skin and should be handled carefully. Selenium bromide, Se_2Br_2, has a higher index than that of any pure liquid so far discovered. Prepared by direct combination, N_{Li} is 1.96 ± 0.01 rising to 2.02 on exposure to atmosphere. Selenium bromide can be mixed with methylene iodide to give a series of liquids of high refractive indices. The use of transparent zinc blende ($N_D = 2.37$) is suggested for use in the construction of refractometers to read above 1.90.

Notes on high index media: I. Hopkins and Wi liams, Ltd., 16–17 Cross St., London, E.C.1, England, supply phenyldi-iodoarsine, *N*1.845. It was found to be transparent enough for immersion work at high magnifications. **II.** Selenium bromide was obtained from the New Jersey Laboratory Supply Co., Newark, N. J. When it is dissolved in methylene iodide, the liquid is too opaque for high-temperature magnifications. **III.** Tetra-iodo-ethylene can be purchased from Rayres and Keeler, 100 North Bond St., W.1, London, England. One solution has an index of 1.81 and the other 1.83. Both are reported to be satisfactory according to B. W. Anderson. (Private communication, J. Gallup.)

Immersion liquids of high refractive index. C. D. WEST. *Amer. Mineralogist*, **21** [4] 245–49 (1936); *Ceram. Abs.*, **15** [6] 185 (1936).

(4) Index of Refraction Determinations

Measurements of refractive indices on the principal optical sections of birefracting minerals in convergent polarized light. F. E. WRIGHT. *Jour. Wash. Acad. Sci.*, **4**, 543 (1914).

Measurement of the refractive index of a drop of liquid. F. E. WRIGHT. *Jour. Wash. Acad. Sci.*, **4**, 269–79 (1914).

Measurement of the extraordinary refractive index of a uniaxial crystal by observations in convergent light on a plate normal to the optic axis. H. E. MERWIN. *Jour. Wash. Acad. Sci.*, **4**, 530–34 (1914).

Determination of the relative refringence of mineral grains under the petrographic microscope. F. E. WRIGHT. *Jour. Wash. Acad. Sci.*, **4**, 389–92 (1914).

Accurate measurement of the refractive indices of minute crystal grains under the petrographic microscope. F. E. WRIGHT. *Jour. Wash. Acad. Sci.*, **5**, 101–107 (1915).

Method for determining the refractive index of liquid without the aid of a refractometer. O. C. VON SCHLICHTEN. *Amer. Mineralogist*, **6** [2] 38 (1921).—Note third paragraph.

Measurement of the indices of refraction of solid by immersion in a liquid heated to a determined temperature.

P. GAUBERT. *Bull. soc. franç. mineral.*, **45**, 89–94 (1922); *Ceram. Abs.*, **3** [2] 60 (1924).

Convenient method for checking the index of a liquid. R. L. RUTHERFORD. *Amer. Mineralogist*, **9** [10] 207–208 (1924).

Precision method for measuring temperatures of refractive index liquids on a crystal refractometer and on a microscope slide. F. W. ASHTON AND W. C. TAYLOR. *Amer. Mineralogist*, **13** [8] 411–18 (1928); *Ceram. Abs.*, **7** [11] 787 (1928).

Double-dispersion method of mineral determination (preliminary paper). R. C. EMMONS. *Amer. Mineralogist*, **13** [10] 504–15 (1928); *Ceram. Abs.*, **8** [1] 70 (1929).

Double-variation method of refractive index determination: II. R. C. EMMONS. *Amer. Mineralogist*, **14** [11] 414–26 (1929); *Ceram. Abs.*, **9** [2] 134 (1930).

Refraction of a liquid between two prisms. MORTON MASIUS AND W. E. LAWTON. *Jour. Opt. Soc. Amer.*, **20**, 271–78 (1930); *Ceram. Abs.*, **10** [5] 390 (1931).

Emmons double-variation apparatus for crystal determination. R. C. EMMONS. *Instrument World*, **4**, 187 (1932); *Ceram. Abs.*, **11** [8] 468 (1932).

Use of a refractometer with a variable refracting angle. ROY D. MCLELLAN. *Amer. Mineralogist*, **18** [4] 138–47 (1933); *Ceram. Abs.*, **12** [8] 304 (1933).

Use of standard glass powders in refractive index determinations. T. SUENO. *Amer. Mineralogist*, **18** [10] 421–30 (1933).

Standardization of index liquids. JEWELL J. GLASS. *Amer. Mineralogist*, **19** [10] 459–65 (1934); *Ceram. Abs.*, **15** [5] 161 (1936).

Transfer of grains from one liquid to another. F. C. CALKINS. *Amer. Mineralogist*, **19** [4] 143–49 (1934).

Cell for refractivity measurements on minute crystals. F. I. G. RAWLINS AND G. W. HAWKSLEY. *Jour. Sci. Instruments*, **11** [9] 282–84 (1934); *Ceram. Abs.*, **14** [2] 44 (1935).

Accuracy of microscopical methods for determining refractive index by immersion. C. P. SAYLOR. *Jour. Research Nat. Bur. Stand.*, **15** [3] 277–94 (1935); R.P. 829; *Ceram. Abs.*, **15** [1] 42 (1936).

Refractometer and other refractive-index methods. B. W. ANDERSON. *Gemmologist* [London], **3**, 216–22 (1934); *Ceram. Abs.*, **14** [11] 294 (1935) (see also abstract by B. W. ANDERSON and C. J. PAYNE, p. 46).

Determination of the refractive indices of minerals by the immersion method. C. B. SLAWSON AND A. B. PECK. *Amer. Mineralogist*, **21** [8] 523–28 (1936); *Ceram. Abs.*, **16** [1] 38 (1937).

(5) Miscellaneous

Modification of the Lasaulx method for observing interference figures under the microscope. F. E. WRIGHT. *Amer. Jour. Sci.*, [4] **22**, 19–20 (1906).

Measurement of the optic axial angle of minerals in thin section. F. E. WRIGHT. *Amer. Jour. Sci.*, [4] **24**, 317–69 (1907).

Measurement of extinction angles in thin sections. F. E. WRIGHT. *Amer. Jour. Sci.*, [4] **26**, 349–90 (1908).

Microscopic arrangement for the examination of opaque crystals. M. FRANÇOIS AND C. LORMAND. *Bull. soc. chim. ind.*, **29**, 366–74 (1921); *Ceram. Abs.*, **1** [10] 247 (1922).

Modification of Lemberg's staining method. E. E. FAIRBANKS. *Amer. Mineralogist*, **10** [5] 126 (1925).—A method for the differentiation of calcite from dolomite is given.

Plane polarized light in the microscopic investigation of ores and metals. FRELEIGH FITZ OSBORNE. *Can. Mining Met. Bull.*, No. 237, pp. 1–13 (1932); *Ceram. Abs.*, **11** [12] 637 (1932).

Coloring of ceramic preparations for microscopic examination. ALPHONS SCHOBLIK. *Keram. Rundschau*, **35**, 430–32 (1927); *Ceram. Abs.*, **8** [11] 845 (1929).

Methods in microscopy. GEORGE L. KEENAN. *Jour. Assn. Official Agr. Chem.*, **15** [4] 626–29 (1932); *Ceram. Abs.*, **12** [3] 124 (1933).

Determination of the optic angle with the universal stage. THEODORE A. DODGE. *Amer. Mineralogist*, **19** [2] 62–75 (1934); *Ceram. Abs.*, **13** [7] 187 (1934).

Portable sedimentary laboratory. F. R. S. HENSON. *Bull. Amer. Assn. Petroleum Geol.*, **18** [12] 1705–1709 (1934); *Ceram. Abs.*, **14** [5] 125 (1935).

(6) Preparation of Thin Sections

Method of preparing thin sections of friable rocks. CLARENCE S. ROSS. *Amer. Jour. Sci.*, [5] **7**, 483–85 (1924); *Ceram. Abs.*, **4** [8] 226 (1925).—On heating bakelite varnish a transformation takes place producing bakelite. By impregnating friable rocks and materials, such as bentonite or clay with bakelite, thin sections of such materials can readily be prepared. The most practical method of impregnating is to soak the specimen in the varnish, allowing the varnish to fill the pores by capillary attraction. Bakelite varnish is soluble in alcohol and ether, with which it may be diluted to make it penetrate more readily into fine pores. After soaking the fragment it is heated for one or two days at from 70° to 90° in order to transform the varnish to bakelite. Bakelite is not softened by heat. To avoid the formation of bubbles, the varnish may be heated to drive off a portion of the volatile matter, but not to hardness. This preheated material is superior for use as a cement. The index of refraction of bakelite is 1.634. In mounting friable rocks, it is suggested to impregnate the rock with bakelite and, after grinding down one face, to mount the specimen to the slide with balsam, using balsam for the cover slip. The high index of bakelite makes it desirable as an imbedding medium for certain materials that have high indices of refraction.

Preparing thin sections of friable materials. FRANCO-BELGIAN ASSOCIATION FOR TESTING MATERIALS. Session of June 23, 1923; *Ceram. Abs.*, **3** [5] 138 (1924).

New method of preparing thin sections from sand. A. MAMOUROVSKY AND I. SAMSONOFF. *Trans. Inst. Econ. Min. and Petrog.*, No. 5 (1923); *Ceram. Abs.*, **3** [11] 326 (1924).

Making thin sections of rocks. MARY G. KEYES. *Amer. Jour. Sci.*, [5] **10**, 538–50 (1925); *Ceram. Abs.*, **5** [3] 102 (1926).—Methods used at the U. S. Geol. Survey for preparing thin sections of rocks are described. Regular methods for firm rocks are given as well as special methods for fragile rocks and rocks containing water solution or minerals altered by heat.

Preparation of thin sections from loose material for petrographic examination. WILLIAM AHERNS AND HER-

MANN WEYLAND. *Centr. Mineral. Geol.*, **A,** 370–75 (1928).

Simple methods for making thin sections. A. A. WEYMOUTH. *Econ. Geol.*, **23** [3] 323–30 (1928).

Abrasives are used to prepare petrographic specimens. HERBERT R. SIMONDS. *Abrasive Ind.*, **11** [4] 28 (1930); *Ceram. Abs.*, **9** [7] 490 (1930).

Preparation of thin sections of Portland cement and other clinkers for petrographic examination. H. G. FISK. *Amer. Jour. Sci.*, [5] **23,** 172–76 (1932).

Thin sections of weathered rocks. THOMAS CLEMENTS. *Eng. Mining Jour.*, **134** [3] 99 (1933); *Ceram. Abs.*, **13** [1] 23 (1934).

Mounting concentrates and tailings for microscopic study. P. H. BIRD. *Eng. Mining Jour.*, **136** [5] 233–34 (1935); *Ceram. Abs.*, **14** [9] 226 (1935).

(7) Quantitative

Microscopic petrography from the quantitative viewpoint. F. E. WRIGHT. *Jour. Geol.*, **20,** 481–501 (1912).

Meaning and microscopic measurement of average particle size. G. ST. J. PERROTT AND S. P. KINNEY. *Jour. Amer. Ceram. Soc.*, **6** [2] 417–20 (1923).—This is a thorough presentation concerning the measurement of particle size and presentation of data.

Discussion on "meaning and microscopic measurement of average particle size." J. C. PEARSON. *Bull. Amer. Ceram. Soc.*, **2** [5] 121–25 (1923); E. P. WIGHTMAN. *Ibid.* **2** [10] 323–24 (1923).

Rapid means for the determination of the quartz content of feldspar. M.C. BOOZE AND A. A. KLEIN. *Jour. Amer. Ceram. Soc.*, **6** [6] 698–705 (1923).—The quartz content is determined by making a rapid fusion of the feldspar without dissolving an appreciable amount of the quartz. A difference of 5% in quartz content can readily be detected. The fusion and optical examination can be made in two hours and does not require a knowledge of microscopy.

Improved Wentworth recording micrometer. WALTER F. HUNT. *Amer. Mineralogist*, **9** [9] 190–93 (1924).

Quantitative mineralogical analysis of rock-dusting materials. A. H. EMERY AND R. DECHICCHIS. *Carnegie Inst. Tech. Mining and Metal Invest. Bull.*, No. 21, pp. 1–41 (1925); *Ceram. Abs.*, **5** [11] 376 (1926).—Methods of quantitative mineralogical analysis are discussed under the following headings: (1) chemical, (2) density, (3) magnetic separation, (4) electrostatic, and (5) mensuration, (*a*) areal and (*b*) linear methods. The mineralogy and quantitative petrography are discussed for the following rock-dusting materials: limestones, gypsum rock, and clays and shales.

Quantitative microscopic analysis. HAROLD L. ALLING AND WILBUR G. VALENTINE. *Amer. Jour. Sci.*, [5] **13** [79] 50–65 (1927); *Ceram. Abs.*, **6** [9] 402 (1927).—There are at least 5 measuring methods: (1) weighing pieces of tinfoil, or similar material, whose size is proportional to the areas of the various minerals in the specimen; (2) measurement of the linear intercepts of the minerals in a section of photograph; (3) measurement of the areas of the minerals on a section of a rock or photograph; (4) counting grains with a grating in the eyepiece; and (5) mechanical separation by Thoulet's solution.

Quantitative determination of quartz in clay. ANON. *Geognostische Jahresheft*, **40,** 105 (1927); *Sprechsaal*, **62** [51] 949 (1929); *Ceram. Abs.*, **9** [5] 387 (1930).—Molten potassium bisulfate does not dissolve quartz, but it dissolves clay completely. The silicic acid which is thereby precipitated in an amorphous state can not be quantitatively separated from quartz. This is accomplished when a certain quantity of ammonium sulfate is added to the potassium bisulfate. Thus the melting temperature is greatly lowered, but the clay goes completely though slowly into solution, and the quartz, in the form of a very fine powder, is not affected. The usefulness of this method is shown in analysis.

Demonstration of a method of measuring particle sizes in ground powders. J. V. RAMSDEN. *Jour. Oil Colour Chem. Assn.*, **11,** 16–17 (1928); *Ceram. Abs.*, **7** [10] 723 (1928).—A small quantity of the sample is mixed with water until a slight turbidity is obtained and then poured into a transparent-bottomed dish made of xylonite. This dish is placed on the stage of an inverted microscope, specially designed for this work. By means of a $^1/_4$-inch microscope objective, the image of the particles is projected on a ground-glass screen on which are ruled lines. These lines are set apart at a distance corresponding to a satisfactory mesh size for the particles. Should a particle be larger than the distance between two lines, the material is condemned. The instrument is in daily use for control testing of barytes.

Optical method for determination of materials in mixtures, residues, etc. HANS WAGNER. *Z. angew. Chem.*, **43** [31] 686–87 (1930); *Ceram. Abs.*, **9** [12] 1100 (1930).—The material to be identified is placed in a special liquid of the same index of refraction on a microscope slide. When held in the light there is noticeable a definite characteristic color. Under the microscope at high magnifications the individual particles are colored characteristically. The mirror of the microscope must be placed so that it does not throw too much light into the tube. By this method barium sulfate in a mixture is colored blue when imbedded in phenyl-mustard oil, whereas the other ingredients of the mixture remain colorless. Aluminium hydrate imbedded in toluol is colored blue. A list of the materials which may be identified is given, together with the liquids to be used and the characteristic colors obtained.

Quantitative microscopic analysis. ELLIS THOMSON. *Jour. Geol.*, **38** [3] 193–222 (1930); *Ceram. Abs.*, **9** [12] 1097 (1930).

Statistical study of some sampling relations with special reference to quantitative microscopy. J. D. WILDMAN. *Jour. Assn. Official Agr. Chem.*, **14** [4] 563–70 (1931); *Ceram. Abs.*, **11** [3] 207 (1932).

Quantitative microscopic methods with an integrating stage applied to geological and metallurgical problems. F. E. THACKWELL. *Econ. Geol.*, **28** [2] 178–82 (1933); *Ceram. Abs.*, **12** [12] 428 (1933).—The integrating stage for use in summing up the proportional amounts of as many as six constituents of a powdered mixture at one time is described and its use explained as applied in the microscopic analysis of rock or ore powders. It is made by E. Leitz, Wetzlar, Germany. Illustrated.

Accuracy of mineralogical measurements. MAX H. HEY. *Mineralog. Mag.*, **23** [144] 495–500 (1934).

Quantitative analysis with the microscope by the point method. A. A. GLAGOLEV. *Eng. Mining Jour.*, **135** [9] 399–400 (1934); *Ceram. Abs.*, **14** [2] 55 (1935).

Microscopic control of particle size in refractory manufacture. W. L. FABIANIC. *Jour. Amer. Ceram. Soc.*, **18** [1] 23–25 (1935).

Experimental and theoretical investigation of quantitative microscopic mineralogical analysis. S. F. RAVITZ AND HAROLD A. STEANE. *Amer. Inst. Mining Met. Engrs. Contribution*, No. 76, 28 pp. (1935); abstracted in Yearbook Sec., *Mining and Met.*, p. 25 (Jan., 1936).— The Rosiwal and the grain-count methods are satisfactory for all the minerals investigated. The Rosiwal method can be applied to unsized minerals. The grain-count method is applicable to grains of approximately the same average diameter.

The Rosiwal method and the modal determination of rocks. E. S. LARSEN AND F. S. MILLER. *Amer. Mineralogist*, **20** [4] 260–74 (1935).

(8) Sedimentation and Heavy Mineral Separation

Method of determining density of minerals by means of Rohrbach's solution having a standard refractive index. H. E. MERWIN. *Amer. Jour. Sci.*, [4] **32**, 425–32 (1911).

Sedimentation as a means of classifying extremely fine clay particles. H. G. SCHURECHT. *Jour. Amer. Ceram. Soc.*, **4** [10] 812–21 (1921).

Clerici's solution for mineral separation by gravity. H. E. VASSAR. *Amer. Mineralogist*, **10** [5] 123–25 (1925).

Heavy liquids for mineralogical analyses. J. D. SULLIVAN. *Bur. Mines Tech. Paper*, No. 381, 26 pp. (1927); *Ceram. Abs.*, **7** [4] 257 (1928).

Rapid specific-gravity determinations with Clerici's solution. K. K. LANDES. *Amer. Mineralogist*, **15** [4] 159–62 (1930); *Ceram. Abs.*, **9** [6] 474 (1930).

Gravity separations. R. C. EMMONS. *Amer. Mineralogist*, **15** [11] 536 (1930).

Factors in sedimentation analysis. E. W. GALLIHER. *Amer. Jour. Sci.*, [5] **26**, 564–68 (1933).

Micropycnometric method for the determination of specific gravities of minerals. F. V. SYROMYATNIKOV. *Amer. Mineralogist*, **20** [5] 364–70 (1935).

Dielectric separation of mineral grains. GILMAN A. BERG. *Jour. Sed. Petrology*, **6** [1] 23–27 (1936); *Ceram. Abs.*, **15** [9] 280 (1936).

(9) Theory

Determination of the optical character of birefracting minerals. F. E. WRIGHT. *Amer. Jour. Sci.*, [4] **20**, 285–96 (1905).

Behavior of crystals in light parallel to an optic axis. C. TRAVIS. *Amer. Jour. Sci.*, [4] **29**, 427–34 (1910).

Transmission of light through inactive transparent crystal plates, with special reference to observations in convergent polarized light. F. E. WRIGHT. *Amer. Jour. Sci.*, [4] **31**, 157–211 (1911).

Index ellipsoid (optical indicatrix) in petrographic microscope work. F. E. WRIGHT. *Amer. Jour. Sci.*, [4] **35**, 133–38 (1913).

Graphical methods in microscopical petrography. F. E. WRIGHT. *Amer. Jour. Sci.*, [4] **36**, 509–39 (1913).

Optical character of the faint interference figure observed in high-power objectives between crossed nicols. F. E. WRIGHT. *Jour. Wash. Acad. Sci.*, **4**, 301–309 (1914).

Precision projection plot. F. E. WRIGHT. *Jour. Wash. Acad. Sci.*, **6**, 521–24 (1916).

Formation of interference figures; study of the phenomena exhibited by transparent inactive crystal plates in convergent polarized light. F. E. WRIGHT. *Jour. Opt. Soc. Amer.*, **7**, 779–817 (1923).

Dispersion of minerals. A. N. WINCHELL. *Amer. Mineralogist*, **14** [4] 125–27 (1929); *Ceram. Abs.*, **8** [6] 446 (1929).—W. notes that the dispersion of mullite is more than double that of sillimanite.

Spherical projection chart for use in the study of elliptically polarized light. F. E. WRIGHT. *Jour. Opt. Soc. Amer.*, **20**, 529–64 (1930).

Shift of the plane of projection in gnomic projection. F. E. WRIGHT. *Amer. Mineralogist*, **17** [9] 423–28 (1932).

Some correct and some incorrect statements of elementary crystallographic theory and methods in current text books. G. TUNELL AND G. W. MOREY. *Amer. Mineralogist*, **17** [8] 365–80 (1932).

Ray-surface, optical indicatrix, and their interrelation: an elementary presentation for petrographers. GEORGE TUNELL. *Jour. Wash. Acad. Sci.*, **23**, 325–38 (1933); *Ceram. Abs.*, **13** [3] 73 (1934).—The two fundamental theories of optical petrography are restated in simple geometrical form and their chief applications in petrography are discussed.

Possible source of error in the determination of symmetry from optical extinction angles. MAX H. HEY. *Mineralog. Mag.*, **23** [141] 367–70 (1933); *Ceram. Abs.*, **13** [4] 103 (1934).

Identification of optically anisotropic crystals by their anisotropic effect between crossed nicols in reflected light. M. BEREK. *Zentr. Mineral. Geol.*, **A**, No. 1, pp. 15–26 (1936); *Ceram. Abs.*, **15** [5] 168 (1936).

XIV. EQUILIBRIUM SYSTEMS

F. P. Hall and Herbert Insley have made a compilation of phase-rule diagrams of interest to the ceramist and the silicate technologist, which was published as the October, 1933, issue of *Jour. Amer. Ceram. Soc.* A revision and supplement to this issue are in preparation.

The following are additional references on the subject.

Some artificial barium–aluminum silicates. A. S. GINZBERG. *Coll. Scientific papers dedicated to F. Y. Levinson-Lessing* [Petrograd], 34 pp. (1915); *Mineralog. Abs.*, **2**, 153; *Ceram. Abs.*, **3** [5] 136 (1924).

Differentiation in silicate liquids. N. L. BOWEN. *Amer. Jour. Sci.*, [4] **39**, 175–91 (1915).

Comparison of heating curves and quenching methods of melting-point determinations. G. W. MOREY. *Jour. Wash. Acad. Sci.*, **13**, 326–29 (1923); *Ceram. Abs.*, **3** [6] 203 (1924).

Formation of eutectic and similar structures in silicate melts. A. F. HALLIMOND. *Trans. Faraday Soc.* (advance proof) (1924); *Ceram. Abs.*, **5** [2] 67 (1926).

Crystalline modifications of $NaAlSiO_4$. N. L. BOWEN AND J. W. GREIG. *Amer. Jour. Sci.*, [5] **10**, 204–12 (1925); *Ceram. Abs.*, **5** [2] 69 (1926).

Equilibrium diagram of ferrous oxide and silica. O. VON KEIL AND A. DAMMANN. *Stahl u. Eisen*, **45**, 890 (1925); *Ceram. Abs.*, **5** [6] 196 (1926).

Observations on magnetite, ilmenite, hematite, and their relations to the system FeO–Fe_2O_3–TiO_2. PAUL RAMDOHR. *Neues Jahrb. Min. Abt. A. Beil.-Bd.*, **54**, 320–79 (1926); *Ceram. Abs.*, **8** [3] 224 (1929).

Practical application of the system Na_2O–Al_2O_3–SiO_2. W. FISCHER. *Keram. Rundschau*, **34**, 849 (1926); *Ceram. Abs.*, **6** [12] 620 (1927).

Devitrification isotherms. ANON. *Sprechsaal*, **59**, 787, 803 (1926); *Ceram. Abs.*, **6** [12] 576 (1927).

Equilibria in the systems of silica, alumina, lime, and soda. WILHELM EITEL. *Glastech. Ber.*, **4** [11] 421–25 (1927); *Ceram. Abs.*, **6** [7] 303 (1927).

Immiscibility in silicate melts: I–II. J. W. GREIG. *Amer. Jour. Sci.*, [5] **13** [73] 1–44; [74] 133–54 (1927); *Ceram. Abs.*, **6** [4] 157 (1927).

Liquid immiscibility in the system FeO–Fe_2O_3–Al_2O_3–SiO_2. J. W. GREIG. *Amer. Jour. Sci.*, [5] **14** [84] 473–84 (1927); *Ceram. Abs.*, **7** [2] 104 (1928).

System alumina–lime–water. ANON. *Rept. Bldg. Research Board, Dept. Sci. Ind. Research* [London], No. 58 (1928); *Ceram. Abs.*, **9** [3] 153 (1930).

Studies on alumina and ferric oxide. W. C. HANSEN AND L. T. BROWNMILLER. *Amer. Jour. Sci.*, [5] **15**, 225–42 (1928); *Ceram. Abs.*, **7** [5] 320 (1928).

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XV. PYROCHEMICAL BEHAVIOR

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is associated with the breakdown of a silicate lattice, α, and with the appearance of Al_2O_3 and sillimanite; (*c*) the Al_2O_3, without showing evidence of the formation of Al_2O_3, persists beyond the finish of the 870°C critical point, but over 1060°C it decreases and eventually disappears. This indicates that the 870°C point is not associated with an alumina change and also shows the existence of sillimanite under 1060°C. Above 1060°C, there is reaction with the formation of mullite.

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XVI. RAW MATERIALS

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(2) Silica

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XVII. REFRACTORIES

(1) Basic Refractories

(a) Dolomite

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Dolomite clinker as a stable basic refractory. M. E. HOLMES, W. J. MCCAUGHEY, AND G. A. BOLE. *Rock Prod.*, **32** [15] 59–67 (1929); *Ceram. Abs.*, **8** [10] 747 (1929).

(b) Magnesite

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Magnesite. W. E. DORNBACH. *Mineral Ind.*, **33,** 460–69 (1924); *Ceram. Abs.*, **5** [5] 159 (1926).

Types of magnesite deposits and their origin. GEORGE

W. Bain. *Econ. Geol.*, **19** [5] 410–33 (1924); *Ceram. Abs.*, **3** [10] 293 (1924).

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Properties of magnesite brick. P. P. Budnikoff and D. A. Nirenshtein. *Ogneuporui*, **3** [6] 437–49 (1935); *Ceram. Abs.*, **15** [6] 182 (1936).

Properties of crystalline MgO. R. W. Ditchburn and J. Harding. *Nature*, **136**, 70–71 (1935).—Synthetic clear crystals of MgO are produced by the Norton Co.

(c) Olivine

Olivine as a refractory. R. A. Heindl and W. L. Pendergast. *Bur. Stand. Jour. Research*, **12** [2] 215–22 (1934); R.P. 645; *Ceram. Abs.*, **13** [5] 119 (1934).—Olivines representing three different deposits in N. C. and one each in Calif., Brit. Columbia, and Russia were tested to determine the possibilities of the material as a refractory. The following results were reported: (1) The chemical analyses showed the silica to range from 40 to 45%, magnesium oxide 40 to 49%, iron as ferrous oxide 7 to 15%, and lesser amounts of alumina, calcium oxide, and titanium. (2) The rate of thermal expansion was fairly regular from room temperature to 900°C except for slight irregularities between 200 and 300°C, and between 650 and 700°C. The total expansion at 900°C, ranged from 0.942 to 1.082%. (3) The true specific gravity ranged between 3.206 and 3.420 for the raw material and between 3.294 and 3.434 for the material after heating to 1400°C. (4) The softening point of the raw ore ranged from cone 30 to above cone 35 except for the material high in calcium oxide which varied from cones 11 to 16. (5) The olivines from N. C. were more refractory than those from the other sources. (6) The petrographic examination indicated the material to be essentially olivine although the percentage of forsterite and fayalite varied appreciably with the respective olivines.

Forsterite and other magnesium silicates as refractories. R. E. Birch and F. A. Harvey. *Jour. Amer. Ceram. Soc.*, **18** [6] 176–92 (1935).

(2) Chrome

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Chrome refractories. J. S. McDowell and H. S. Robertson. *Jour. Amer. Ceram. Soc.*, **5** [12] 865–87 (1922).—A compilation from the available literature is presented, giving the more important data on chromite and chrome refractories. A bibliography is included.

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Petrography and heat treatment of chromite refractories. G. E. Seil. *Penn. State Coll. Mineral Ind. Expt. Sta. Bull.*, No. 14, pp. 40–56 (1934); *Ceram. Abs.*, **15** [1] 23 (1936).

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(3) Graphite

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Graphite as a refractory. Richard H. Stone. *Jour. Amer. Ceram. Soc.*, **16** [2] 96–101 (1933).

(4) General

Common refractory oxides. Robert B. Sosman. *Jour. Ind. Eng. Chem.*, **8** [11] 985–90 (1916); *Amer. Mineralogist*, **2** [3] 38 (1917).

Progress report on specifications for refractories. R. F. Geller. *Jour. Amer. Ceram. Soc.*, **6** [10] 1098–1111 (1923).—Following a conference with producers and consumers of refractories, a series of proposed laboratory tests were conducted on forty-one commercial brands of brick. The work included reheating at 1450°C, quenching, load test, fusion point determination, chemical analyses, and petrographic examination. Results of tests are presented.

Micro-examination of steel-making refractories. W. J. Rees. *Trans. Faraday Soc.*, **21**, 293–96 (1925); *Ceram. Abs.*, **5** [10] 317 (1926).

An eighteen months' high-temperature test on refractory test specimens. F. H. Riddle and A. B. Peck. *Jour. Amer. Ceram. Soc.* **9** [1] 1–22 (1926).

Thermal expansion of fireclay brick. A. E. R. Westman. *Univ. Ill. Eng. Expt. Sta. Bull.*, No. 181, 27 pp. (1928); *Ceram. Abs.*, **8** [6] 416 (1929).

Constitution of refractories. Anon. *Blast Fur. Steel Plant*, **16** [9] 1233–36 (1928); *Ceram. Abs.*, **7** [12] 836 (1928).

Influence of firing on the chemical and physical properties of refractory clays. W. Miehr, J. Kratzert, and H. Immke. *Tonind.-Ztg.*, **52** [16] 280–82; [17] 298–301; [18] 323–25 (1928); *Ceram. Abs.*, **7** [8] 545 (1928).

Optical methods as an aid to the study of refractories. T. N. McVay. *Jour. Amer. Ceram. Soc.*, **12** [7] 455–56 (1929).—The application of the petrographic microscope as an aid to the study of designating impurities in raw materials has proved successful. By the same methods, fired

refractories may be classified and the effects of bonds tested. Optical tests should chiefly be used to supplement and not to displace other methods of examinations.

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X-ray study of fire brick. A. E. R. WESTMAN. *Univ. Ill. Eng. Expt. Sta. Bull.*, No. 193, 16 pp. (1929); *Ceram. Abs.*, **9** [6] 430 (1930).

Manufacture of electrocorundum and silicon carbide. R. SCHNEIDLER. *Feuerfest*, **8** [9] 129–32 (1932); *Ceram. Abs.*, **12** [2] 62 (1933).

Applying petrographic methods to refractories research. L. J. TROSTEL. *Amer. Refrac. Inst. Tech. Bull.*, No. 37, 7 pp. (1933); *Ceram. Abs.*, **12** [7] 267 (1933).—T. indicates the value and limitations of petrographic studies which disclose crystalline changes not shown by chemical analysis or physical tests. The petrographic microscope and auxiliaries, such as refractive index liquids, apparatus for preparation of thin sections, camera, and quenching furnace, are briefly described. The experience of most of the laboratories that have used petrographic methods is that the insight gained regarding composition and reaction of the products more than compensates for the rather high cost.

Thermal expansion of refractories to 1800°C. R. A. HEINDL. *Brick Clay Rec.*, **83** [2] 59–62 (1933); *Bur. Stand. Jour. Research*, **10** [6] 715–35 (1933); *Ceram. Abs.*, **12** [9] 330 (1933).

Microscopic testing of ceramic raw materials. FRITZ KÄSTNER. *Sprechsaal*, **67** [45] 685–88 (1934); *Ceram. Abs.*, **14** [4] 100 (1935).—Directions for using petrographic microscopes for investigation of quartz, kaolin, and clay are given. Tables with data on feldspars and heavy liquids for separations and a literature index are given.

Relation between uncombined quartz and thermal expansion of ceramic bodies. W. R. MORGAN. *Jour. Amer. Ceram. Soc.*, **17** [5] 117–21 (1934).

Glassy phase in the manufacture and use of refractories. G. W. MOREY. *Bull. Amer. Ceram. Soc.*, **14** [6] 202–206 (1935).

Advanced and refined technique in the petrographic study of crystalline refractories. R. B. MCCORMICK. *Jour. Amer. Ceram. Soc.*, **19** [1] 7–13 (1936).

X-ray and optical investigation of the serpentine minerals. GEORGE C. SELFRIDGE, JR. *Amer. Mineralogist*, **21** [8] 463–503 (1936).

(5) Glass House

Notes on the behavior of refractories in glassmelting furnaces. HERBERT INSLEY. *Jour. Amer. Ceram. Soc.*, **7** [8] 583–93 (1924).—Microscopic examination of used glasshouse refractories gives evidence about the transformations that have taken place during use and relative solubilities of constituents of the refractories in the glass.

Alumina-silica minerals in glasshouse pots and tank blocks. W. J. REES. *Pottery Gaz.*, **49** [567] 1518 (1924); *Ceram. Abs.*, **4** [3] 64 (1925).

Fundamental principles governing the corrosion of a fireclay refractory by a glass. R. B. SOSMAN. *Jour. Amer. Ceram. Soc.*, **8** [4] 191–205 (1925).

Use of sillimanite in glass furnace practice. F. G. CLARK AND W. J. REES. *Jour. Soc. Glass Tech.*, **9** [36] 383–88 (1925); *Ceram. Abs.*, **5** [5] 156 (1926).

A note on some factors governing the resistance of pots to glass attack. J. F. HYSLOP. *Jour. Soc. Glass Tech.*, **10** [38] 148–52 (1926); *Ceram. Abs.*, **5** [11] 362 (1926).—X-ray diffraction patterns of sections of two series of pots, which had been used against the same glass and of which one series gave exceptionally long life, while the life of the other series was much shorter although still satisfactory, showed that the body of the used pots consisted essentially of mullite, cristobalite, and tridymite. The porcelain layer adjacent to the glass in the better series of pots was very thin and uniform in thickness and consisted of mullite, cristobalite, and glass when slowly cooled. When annealed at 1350°C and water-quenched, the silica remained in solution in the glass and the X-ray pattern showed only mullite. The porcelain layer from the poorer series of pots was much thicker and more irregular and showed only mullite and glass when slowly cooled, indicating that the slower attack on the better series of pots might have been due to the glassy portions of the porcelain layers of this series being more highly siliceous than that of the poorer series.

Observations of surface deposits formed in glass furnace regenerators. HERBERT INSLEY. *Jour. Amer. Ceram. Soc.*, **9** [10] 635–38 (1926).—Two high alumina refractory brick which had been used in glass-furnace regenerators were examined with the petrographic microscope. The deposits formed on the surface of the brick through reaction with the dusts and gases of the furnace atmosphere were found to be composed principally of nephelite, carnegieite, and corundum. Nephelite and carnegieite probably can form only in those parts of glass furnaces where the temperature is considerably lower than that required to melt the glass, but corundum may be formed at melting temperatures.

Action of molten glass on refractories. ANON. *Glass Ind.*, **7** [8] 193 (1926); reprinted from *Keram. Rundschau*, **33**, 463–64 (1926); *Ceram. Abs.*, **5** [10] 315 (1926).

Deterioration and failure of glassworks refractories. B. M. PEARSON. *Glass Ind.*, **8** [6] 127–33 (1927); *Ceram. Abs.*, **6** [8] 347 (1927).

Refractories for the glass industry. W. J. REES. *Glass*, **4** [11] 468 (1927); *Ceram. Abs.*, **7** [8] 545 (1928).

Corrosive action of glass on tank blocks. S. R. SCHOLES. *Fuels and Fur.*, **6** [2] 183–86 (1928); *Ceram. Abs.*, **7** [6] 369 (1928).

Glass tank refractories and their chemical relationship to molten glass. KAI CHING LU. *O. S. U. Eng. Expt. Sta. Bull.*, No. 44 (1928); *Ceram. Abs.*, **8** [3] 194 (1929).

Resistance of refractories to glass corrosion. K. SILK. *Pottery Gaz.*, **53** [618] 1921–22 (1928); *Ceram. Abs.*, **8** [2] 122 (1929).

Composition, structure, and origin of stalactites in burners of glass furnaces. D. S. BELIANKIN* AND M. A. BESBORODOV. *Keram. Rundschau*, **36**, 573–76, 596–99 (1928); *Ceram. Abs.*, **9** [1] 20 (1930).

Study of refractory blocks in a small experimental glass tank. W. L. PENDERGAST AND HERBERT INSLEY. *Jour. Amer. Ceram. Soc.*, **12** [2] 123–41 (1929).—The results of

* Correct spelling Belyankin.

tests made in nine runs of the furnace, each run continuing for approximately 30 days, are given. The resistance of the refractories to glass attack apparently does not depend entirely upon chemical composition and porosity of the refractories, but is probably related also to (1) the size of pores, (2) the relative composition of grog and bond, and (3) the degree of adherence between particles in the refractory.

Some formations in glassmelting furnaces. D. S. BELIANKIN* AND M. A. BESBORODOV. *Keram. Rundschau*, **37**, 394–96, 413–14 (1929); *Ceram. Abs.*, **9** [12] 1036 (1930).

Petrographic investigation of zone formation in silica refractories in glassmelting furnace. N. G. KAZNAKOVA. *Ogneuporui*, **3** [9] 667–71 (1935); *Ceram. Abs.*, **15** [5] 153 (1936).

(6) Silica Brick

Study of the silica refractories. J. SPOTTS MCDOWELL. Reprinted from *Bull. Amer. Inst. Mining Engrs.*, No. 116 (Nov., 1916).

Manufacture and tests of silica brick for by-product coke ovens. K. SEAVER. *Trans. A.I.M.M.E.*, **53**, 125–43 (1916).

Inversion of silica brick. A. SCOTT. *Trans. Ceram. Soc.* [Eng.], **17** [1] 137–52 (1917).

Silica refractories. DONALD W. ROSS. *Jour. Amer. Ceram. Soc.*, **1** [7] 477–501 (1918).

Constitution and microstructure of silica brick. HERBERT INSLEY AND A. A. KLEIN. *Bur. Stand. Tech. Paper*, No. 124, 31 pp. (1919); *Jour. Frank. Inst.*, **187**, 628–30; *Jour. Amer. Soc. Mech. Eng.*, **41**, 470 (1919).

Variation in heat treatment of a silica brick in the crown of a tunnel kiln. A. A. KLEIN AND L. S. RAMSDELL. *Jour. Amer. Ceram Soc.*, **4** [10] 805–11 (1921).

Comparative study of American and German quartzites as raw materials for the silica brick industry. K. ENDELL. *Jour. Amer. Ceram. Soc.*, **4** [12] 953–60 (1921).

Constitution and microstructure of silica brick and chamotte block used in tank furnace. ZENZIRO UNENO. *Research Lab. Asahi Glass Co. Rept.*, No. 10, 67 pp. (1923); *Ceram. Abs.*, **4** [3] 75 (1925).

Effect of repeated firing on the structure and properties of lime-bonded silica brick. W. HUGILL AND W. J. REES. *Trans. Ceram. Soc.* [Eng.], **25** [1] 82–90 (1925–26); *Ceram. Abs.*, **5** [7] 218 (1926).

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Microstructure of silica brick. N. N. SMIRNOV. *Trans. State Expt. Inst. Silicates* [U.S.S.R.], **20**, 5–18 (1926); *Ceram. Abs.*, **8** [4] 278 (1929).

Microscopic investigation of quartzites and silica brick containing lime. J. E. HIBSCH. *Feuerfest*, **2** [10] 93–95; [12] 113–17 (1926); *Ceram. Abs.*, **6** [7] 287 (1927).

Properties of silica brick from coke-oven walls. S. S. COLE. *Jour. Amer. Ceram. Soc.*, **9** [4] 197–202 (1926).—Silica shapes from coke ovens were tested to see what change had occurred after long service. Brick from Chicago and Birmingham districts were examined. Chemical analyses, specific gravity, porosity, fusion values, and petrographic examinations were obtained on the samples.

Further note on the influence of iron oxide in promoting the inversion of silica. W. J. REES. *Trans. Ceram. Soc.* [Eng.], **25** [4] 314–17 (1925–26); *Ceram. Abs.*, **6** [9] 383 (1927).

Importance of the silica inversions to the combustion process and to the behavior of refractories in use. E. STEINHOFF. *Tonind.-Ztg.*, **51** [23] 364–66; [25] 400–403 (1927); *Ceram. Abs.*, **6** [10] 448 (1927).

Influence of iron oxide and iron sulfides on the rate of quartz conversion in commercial silica brick manufacture. W. HUGILL AND W. J. REES. *Trans. Ceram. Soc.* [Eng.], **25** [4] 309–13 (1925–26); *Ceram. Abs.*, **6** [9] 383 (1927).

Relation of the silica transformations to the behavior of refractories in use. E. STEINHOFF. *Gas- u. Wasserfach*, **70**, 237–40 (1927); *Ceram. Abs.*, **6** [7] 289 (1927).

Influence of impurities on the properties of silica brick. K. ENDELL AND R. HARR. *Rev. mat. constr. trav. pub.*, No. 230, pp. 252–53B (1928); *Ceram. Abs.*, **8** [10] 740 (1929).

Important structural characteristics of raw materials in the manufacture of silica brick. P. JUDINSON. *Feuerfest*, **5** [10] 165–69 (1929); *Ceram. Abs.*, **9** [2] 107 (1930).

Change of quartz into tridymite in silica brick in the presence of mineralizers and a partial substitution of quartzites by sand in a silicate bed. P. P. BUDNIKOFF AND I. S. SMELJANSKY. *Research Inst. Silicate Ind.* [Charokov], No. 2, 51 pp. (1929); No. 15, 27 pp. (1930); *Ceram. Abs.*, **9** [7] 540 (1930); **10** [12] 847 (1931).

Silica as a refractory in the steel plant. R. B. SOSMAN. *Blast Fur. Steel Plant*, **17** [6] 920–24 (1929); *Ceram. Abs.*, **8** [8] 585 (1929).

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Silica fire brick. GEOFFREY W. M. REES. *Refrac. Jour.*, **4** [41] 142–47 (1929); *Ceram. Abs.*, **8** [5] 344 (1929).

Silica as a refractory in the steel industry. R. B. SOSMAN. *Trans. Amer. Iron Steel Inst.* (May, 1929).

Microstructure of some west-of-England siliceous brick. J. M. COON. *Trans. Ceram. Soc.* [Eng.], **29** [4] 125–37 (1930); *Ceram. Abs.*, **9** [11] 946 (1930).

Tridymitization of quartzites. P. P. BUDNIKOFF, G. V. KUKOLEV, AND I. S. SMELJANSKY. *Sprechsaal*, **65** [29] 529–33 (1932); *Ceram. Abs.*, **11** [11] 574 (1932).

Comparison of used silica brick from insulated and uninsulated basic open-hearth roofs. FRED A. HARVEY. *Jour. Amer. Ceram. Soc.*, **18** [3] 86–94 (1935).

Effect of insulation on the silica refractories of an open-hearth steel furnace roof. LEWIS B. MILLER. *Bull. Amer. Ceram. Soc.*, **14** [11] 359–64 (1935).

Application of physicochemical principles to the manufacture of refractory products: I–II. M. LÉPINGLE. *Ind. chim. Belge*, **6** [6] 217–22 (1935); **7** [2] 43–55 (1936); *Ceram. Abs.*, **15** [2] 62; [5] 151 (1936).

XVIII. SLAGS

Proposed method for studying the attack of molten slags and glasses upon refractory materials. C. I. ROSE. *Jour. Amer. Ceram. Soc.*, **6** [12] 1242–47 (1923).—The solution and penetration of the refractory are measured by means of a micrometer and a simple microscope.

* Correct spelling Belyankin.

Thermal and microscopical investigations of the cupola-furnace slag systems $MnO–Al_2O_3–SiO_2$, $MnS–MnSiO_3$, and $CaS–CaSiO_3$. O. GLASER. *Centr. Mineral Geol.*, **A,** 81–96 (1926); *Ceram. Abs.*, **6** [10] 474 (1927).

Laboratory study of slag erosion. S. J. MCDOWELL. *Mech. Eng.*, **40** [5] 429–30 (1927); *Blast Fur. Steel Plant*, **15** [6] 286–87 (1927); *Ceram. Abs.*, **6** [9] 385 (1927).—Progress report of the A.S.M.E. Special Research Comm. on Boiler Furnace Refractories.

Petrographic study of slags from boiler furnaces. SAMUEL J. MCDOWELL AND H. C. LEE. *Jour. Amer. Ceram. Soc.*, **11** [1] 35–41 (1928).—Observations are based on a microscopic study of the effect of slags, particularly those of an Illinois coal, on refractories. A mineralogical relation is shown between the slag and the refractory used. The principal phases present in a cooled slag are (1) a plagioclase feldspar, (2) magnetite or hematite, (3) mullite with iron oxide in solid solution, and (4) glass. The so-called "interface" between slag and refractory is largely crystalline upon cooling and consists principally of mullite which, surrounded by the slag, has grown from fine needles in the refractory to larger ones. In high-alumina refractories where diaspore is present, the stained interface is much thicker and grains of corundum are formed. This zone of crystallization may be conducive to spalling. The effect of slags on various refractories is discussed.

Effect of coal ash on refractories. T. N. MCVAY AND R. K. HURSH. *Jour. Amer. Ceram. Soc.*, **11** [11] 868–73 (1928).—The action of coal ash on the following types of refractories was studied: (1) high diaspore brick, (2) fireclay refractories with very little quartz, (3) fireclay refractories with considerable quartz, (4) refractories containing a mixture of diaspore and fire clay, and (5) andalusite refractories.

Well crystallized blast-furnace slag (melilite–schefferite–olivine). FRANZ ANGEL. *Z. Krist.*, **68,** 157–76 (1928); *Ceram. Abs.*, **8** [9] 686 (1929).

Study of crystalline compounds formed in slags on boiler-furnace refractories. T. A. KLINEFELTER AND E. P. REXFORD. *Trans. Amer. Soc. Mech. Eng.*, **51** [22] 347–48 (1929); *Ceram. Abs.*, **9** [3] 195 (1930).

Petrographic study of lead and copper furnace slags. ROY D. MCLELLAN. *Amer. Inst. Mining Met. Engrs. Tech. Pub.*, No. 305, Class D; *Mining and Met.*, **11** [279] 18–19 (1930); *Ceram. Abs.*, **9** [5] 386 (1930).—This paper has resulted from the study of thin sections from a large number of commercial lead and copper furnace slags with the help of the petrographic microscope.

Slag system: calcium oxide–iron oxide–silicon dioxide. E. F. KOHLMEYER. *Metallbörse*, **20,** 1828–29 (1930); *Ceram. Abs.*, **10** [2] 146 (1931).

Action of slags on fire brick and boiler-furnace settings. T. A. KLINEFELTER AND E. P. REXFORD. *Trans. Amer. Soc. Mech. Eng.*, **53** [14] 301–305 (1931); *Ceram. Abs.*, **11** [1] 38 (1932).—The paper presents a rational discussion of the action of coal ash upon boiler-furnace refractory walls and shows the consistency of results from the authors' laboratory slag tests with fire brick under actual service conditions in boiler furnaces (see also *Ceram. Abs.*, **10** [6] 436 (1931)).

Investigation of the action of coal-ash slags on fire brick by microscopic methods. HAROLD E. SIMPSON. *Jour. Amer. Ceram. Soc.*, **15** [10] 520–35 (1932).—The action of coal-ash slags on firebrick refractories was studied by microscopic examination of thin sections prepared from quenched samples of ash and refractory heated together. The eight refractories used varied as to clays, method of fabrication, grind, and firing treatment. Six different coal ashes varied from highly corrosive to noncorrosive ashes. Samples were quenched at intervals in the range of 2200 to 2800°F, and the critical temperature or maximum safe operating temperature of all combinations of slag and refractory was determined. These values are presented together with a discussion of the various minerals formed.

Refractories for use in sulfate recovery furnaces of the pulp and paper industries. J. A. CUNLIFFE AND H. E. CLEM. *Jour. Amer. Ceram. Soc.*, **15** [6] 321–33 (1932).

Effects of variations in the alumina-silica ratio in fused refractory materials upon resistance to metal oxides. C. MCMULLEN, A. A. TURNER, AND G. J. EASTER. *Jour. Amer. Ceram. Soc.*, **18** [1] 30–33 (1935).

Minerals of the lead slags: application of petrologic methods to slags. W. FABER. *Chem. Erde*, **10,** 67–115 (1935); *Ceram. Abs.*, **15** [5] 168 (1936).

Mechanism of slag attack on refractory materials. J. H. CHESTERS. *Refrac. Jour.*, **11** [4] 179 (1935); *Ceram. Abs.*, **14** [7] 166 (1935).

Testing refractories against the corrosive action of electric furnace phosphate slags. GORDON D. POLE AND D. G. MOORE. *Jour. Amer. Ceram. Soc.*, **19** [10] 259–70(1936).

XIX. POTTERY AND PORCELAIN

Constitution and microstructure of porcelain. A. A. KLEIN. *Bur. Stand. Tech. Paper*, No. 80, 38 pp. (1916).

Constitution and microstructure of porcelain. A. A. KLEIN. *Trans. Amer. Ceram. Soc.*, **18,** 377–423 (1916).—This is of primary importance and also contains a review of earlier literature on the subject.

Effect of time and temperature on the microstructure of porcelain. A. B. PECK. *Jour. Amer. Ceram. Soc.*, **2** [3] 175–94 (1919).

Progress of vitrification and solution in some porcelain mixtures. A. S. WATTS. *Jour. Amer. Ceram. Soc.*, **2** [5] 400–409 (1919).

Further studies on porcelain. F. H. RIDDLE. *Jour. Amer. Ceram. Soc.*, **2** [10] 812–27 (1919).

Time and temperature of firing as factors influencing the constitution and microstructure of a porcelain body. A. A. KLEIN. *Jour. Amer. Ceram. Soc.*, **3** [12] 978–83 (1920).

Comparative examination of the structure of Japanese and foreign porcelains. R. SHIGEMUNE. *Tokyo Ind. Lab. Rept.*, **17** [6] 59 pp. (1922); *Ceram. Abs.*, **2** [7] 162 (1923).

Studies of changes in the physical properties of a hard porcelain caused by varying the feldspar from Na to K feldspar and by varying the firing treatment. E. ROTH.

Sprechsaal, **55**, 533–34 (1923); *Ceram. Abs.*, **2** [5] 102 (1923).

Contribution to the better knowledge of genuine hard porcelain. K. H. REICHAU. *Trans. Ceram. Soc.* [Eng.], **23**, 145–53 (1923–24); *Ceram. Abs.*, **3** [11] 319 (1924).

Influence of grain size on the solubility of quartz in feldspar in porcelain fire. KURT WETZEL. *Ber. deut. keram. Ges.*, **5**, 2 (1924); *Ceram. Abs.*, **4** [5] 137 (1925).—Quartz grains of uniform size are dissolved at a uniform rate by melting feldspar. In the series potash-feldspar-quartz, the solubility of the coarsest grained quartz used was 95% rising gradually to 100% for the finest grains. If a mixture of grains is used the finest will be completely dissolved and the coarser ones only partially. Practically no difference in solubility was noted between Hohenbocka sand and Norwegian quartz. Different grades of feldspar showed more marked variation. Norwegian feldspar has a higher solubility than soda feldspar from northern Bavaria. Addition of a strong flux such as lime or magnesia increases the solubility. A comparison between the solubility of feldspar and a porcelain body showed close similarity.

Relation between the constitution and properties of porcelain. R. RIEKE. *Ber. deut. keram. Ges.*, **6**, 144 (1925); *Ceram. Abs.*, **5** [12] 411 (1926).

Constitution of porcelain. ROBERT SCHWARZ. *Keramos*, **5** [12] 535–40 (1926); *Ceram. Abs.*, **6** [9] 392 (1927).—A thorough discussion of the question of the constitution of porcelain under the following subtopics: (1) isolation of mullite from porcelain, (2) effect of repeated firings on the properties, (3) microstructure, and (4) the question of the origin of the mullite in porcelain.

Effect of various forms of silicic acid on porcelain bodies. HANS HIRSCH. *Ber. deut. keram. Ges.*, **7** [2] 49–87 (1926); *Ceram. Abs.*, **6** [6] 229 (1927).

Thermal expansion of whiteware materials and bodies over a wide temperature range. W. L. SHEARER AND W. R. WYCKOFF. *Ceramist*, **7** [6] 349–85 (1926); *Ceram. Abs.*, **5** [7] 223 (1926).

Microstructure of porcelain insulator. RYOICHI SHIGEMUNE. *Tokyo Ind. Lab. Rept.*, **22** [5] 44 pp. (1927); *Ceram. Abs.*, **7** [3] 178 (1928).

Microstructure of earthenware. H. INSLEY. *Jour. Amer. Ceram. Soc.*, **10** [5] 317–26 (1927).

Discussion on "The effect of calcined kyanite in porcelain bodies." L. NAVIAS AND S. J. MCDOWELL. *Jour. Amer. Ceram. Soc.*, **10** [5] 327–29 (1927).

Determination of mullite in a porcelain body. T. N. MCVAY. *Jour. Amer. Ceram. Soc.*, **10** [1] 62–63 (1927).

Constitution of porcelains. ROBERT SCHWARZ AND HERBERT MERCK. *Z. anorg. allgem. Chem.*, **156**, 1–17 (1926); *Ceram. Abs.*, **6** [3] 110 (1927).

Fibrous structure of porcelain bodies. RYOICHI SHIGEMUNE. *Jour. Jap. Ceram. Assn.*, **35** [420] 615–21 (1927); *Ceram. Abs.*, **8** [1] 51 (1929).

Vitrification of ceramic bodies. ANON. *Bur. Stand. Tech. News Bull.*, No. 133, pp. 70–71 (1928); *Ceram. Abs.*, **7** [8] 546 (1928).—An investigation of the boundary of the field of mullite in the K_2O–Al_2O_3–SiO_2 system is being made. Minerals, used chiefly in making melts, are mixed in proper proportions with dextrin and extruded from a glass tube. The mixture is then melted, quenched, and examined microscopically. Melts containing varying amounts of orthoclase, kaolin, and flint were made. Mullite crystals were found to occur in melts containing at least 30% kaolin, those with less containing mostly glass. There is an almost constant variation in the indices of the glasses ranging from 1.48 with 10% kaolin to 1.54 with 90%. The amount of mullite increases with the index of the glass. Leucite-kaolin melts show practically the same results as do orthoclase-kaolin melts.

Use of fused silica as a raw material in the manufacture of porcelain. A. E. R. WESTMAN. *Jour. Amer. Ceram. Soc.*, **11** [2] 82–89 (1928).

Structural research on hard porcelain. O. KRAUSE. *Z. tech. Physik*, **9**, 247–63 (1928); *Ceram. Abs.*, **8** [2] 133 (1929).

Solubility of quartz and clay in feldspar. C. W. PARMELEE AND C. R. AMBERG. *Jour. Amer. Ceram. Soc.*, **12** [11] 699–710 (1929).

Influence of grain size of nonplastics on physical-mechanical properties of hard porcelain. P. FILOSSOFOV AND A. STCHEPETOW. *Keram. Rundschau* **37**, 341–45 (1929); *Ceram. Abs.*, **9** [12] 1064 (1930).

Glass phase in porcelain. HOBART M. KRANER. *Jour. Amer. Ceram. Soc.*, **12** [6] 383–89 (1929).—K. discusses the probable development taking place in porcelain during the firing and overfiring processes. Evidence is given for the belief that mullite solution in the glass may be the cause of change of characteristics of the porcelain. Observations in the clay–flint–feldspar system and in the magnesia-alumina–silica ternary are discussed in connection with the above subject.

Mullite formations in ceramic bodies. L. SOLODOVNIKOVA. *Trans. Ceram. Research Inst.* [U.S.S.R.], No. 25, 11 pp. (1930); *Ceram. Abs.*, **10** [3] 228 (1931).

Influence of time on the maturing temperature of whiteware bodies: II. C. L. NORTON, JR. *Jour. Amer. Ceram. Soc.*, **14** [3] 192–206 (1931).—This investigation deals with the microscopic examination of three of the whiteware bodies which were described in Part I of this paper (F. H. NORTON and F. B. HODGDON, *ibid.*, pp. 177–91). With respect to the influence of time of firing upon the crystalline texture, it was found that with samples which showed the same degree of maturity by physical test, the long-fired, low-temperature samples showed more quartz solution as well as more mullite development than the samples fired more quickly at higher temperatures.

Researches on porcelain by means of a polarization microscope. E. HERLINGER AND A. UNGEWISS. *Sprechsaal*, **65** [31] 571–73; [32] 589–91 (1932); *Ceram. Abs.*, **11** [11] 581 (1932).

Auxiliary fluxes in ceramic bodies. PAUL F. COLLINS. *Jour. Amer. Ceram. Soc.*, **15** [1] 17–27 (1932).

Microstructure of high-tension insulators. G. A. SOKOLOV. *Ceramics & Glass*, **8** [5–6] 18–23 (1932); *Ceram. Abs.*, **11** [11] 582 (1932).

Effects of particle size of a potter's "flint" and a feldspar in whiteware. R. F. GELLER, D. N. EVANS, AND A. S. CREAMER. *Bur. Stand. Jour. Research*, **11** [3] 327–40 (1933); R. P. 594; *Ceram. Abs.*, **12** [12] 427 (1933).

Notes on some effects of the variety of flint used on the properties of a hotel china body. C. L. THOMPSON. *Jour. Amer. Ceram. Soc.*, **17** [9] 268–71 (1934).—Pebble,

sand, rock, and tripoli flint were used in a hotel china composition. The variety of flint was found to have little effect on the water absorption of the body fired to cone 10, on its linear thermal expansion to 300°C, or on its impact strength. The pebble-flint body crazed most easily in a water-dip test, while the sand-flint body was most resistant to crazing. The body containing rock flint was superior in translucency, the sand flint next, the tripoli flint third, while the pebble-flint body was practically opaque.

Microscopic study of Russian chinaware. G. J. MIDDLETON. *Bull. Amer. Ceram. Soc.*, **14** [3] 101–104 (1935).

Physical-chemical reactions in firing whiteware. T. N. MCVAY. *Jour. Amer. Ceram. Soc.*, **19** [7] 195–201 (1936).

PART II. OUTLINE FOR EXAMINATION OF CRYSTAL GRAINS

BY KENNETH E. BUCK

NOTE. In the preparation of grains, crush the material rather than grind; standardize on grains of approximately one size, such as between 100- and 200-mesh.

I. Observation in Plane Polarized Light with Lower Nicol Only

Optical System: lower nicol, objective, and eyepiece.

(A) Note color of mineral (frequently helpful when other optical properties are similar to those in other minerals).

(B) Note if color of mineral changes on rotation of stage (pleochroism). Connect as far as possible the changes in color with vibration direction of polarizer and crystallographic directions (cleavages, etc.).

(C) Note crystal outline, if any.

(D) Note any inclusions, their shape and arrangement.

(E) Note approximate value for index of refraction (Becke line method or method of central illumination).

II. Observations in Plane Polarized Light with Crossed Nicols

Optical System: lower nicol, objective, upper nicol, and eyepiece.

(A) Note if crystal remains dark during complete revolution of stage (indicates mineral is isotropic).

(B) Note if crystal is alternately light and dark during rotation of stage (indicates mineral is anisotropic).

(C) Note if crystals showing highest order of color have higher or lower birefringence (order of color) than that of a reference crystal of same grain size (quartz). This is indicative of the maximum spread between indices.

The grains showing the highest order of color are those with the fastest and slowest rays (biaxial) or ordinary and extraordinary rays (uniaxial) broadside (or nearly so) and are useful in determining the index of refraction of the fastest and slowest ray (Becke line method).

(D) Locate the grain or grains of the lowest order of color (gray, etc.) that remain lighted at least to some degree throughout complete rotation of stage. This orientation will (or nearly so) show the emergence of an optic axis and is the most valuable orientation for observations in convergent polarized light to determine whether uniaxial or biaxial, positive or negative (see chart).

III. Observations in Convergent Polarized Light between Crossed Nicols

Optical System: lower nicol, condensing lens, objective, upper nicol, and pin-hole cap, or:

Lower nicol, condensing lens, objective; upper nicol, Bertrand lens, and eyepiece.

(A) Obtain interference figures from grains showing lowest order of color. Note whether uniaxial or biaxial.

Note whether positive or negative.

Note direction of ω (uniaxial) or β(biaxial) and measure index of refraction by Becke line method.

(B) Locate, if possible, when crystal is biaxial, a grain showing emergence of acute bisectrix. Even if not perfectly centered, it may reveal sufficient of the movement of the shadows to visualize the whole figure and its center. To aid in this visualization when figure is not perfectly centered, refer to perfect figure obtainable from mica plate used as a specimen. When movement of shadows is properly identified, this interference figure will serve as check on determining crystal classification, sign and reveal vibration directions of obtuse bisectrix, which is either α or γ according to sign of crystal and also vibration direction of β. Indices of refraction of these two rays can then be measured; β will be broadside in this figure, but the other ray, α or γ, will be less than full value in proportion to eccentricity of figure off center of field.

(C) Interference figure from grains showing highest order color is of little value. Hyperbolas (hazy) flash into field, in opposite quadrants, and out of field in adjacent quadrants in 10 to 20° rotation in the case of both uniaxial and biaxial crystals. The real value of such grains is in that they have ω and ϵ or α and γ vibrating at right angles to one another and broadside to line of vision or nearly so. Both can be measured for index of refraction and then properly named by using information on crystal classification and sign previously determined.

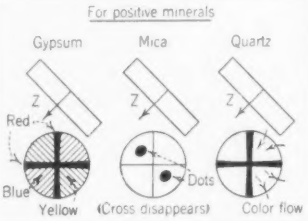
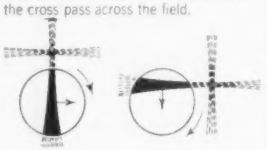
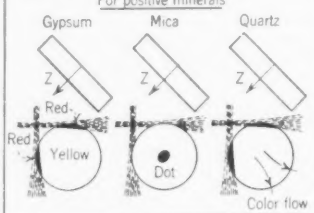
ERRATA: Corrections on "Outline for Examination of Crystal Grains" (p. 62).

(1) Under heading "Optical Reactions in Convergent Light" *Bertrand lens* (not Bertram lens).

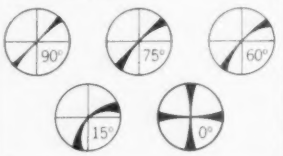
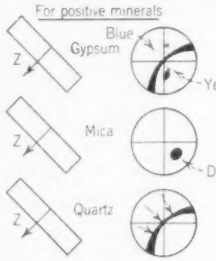
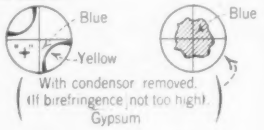
(2) Under heading "Optical Reactions with Accessories" in the third section from the top, the words "Reactions Not Useful" should precede the "Note." "Reactions Not Useful" should also be inserted in the last two sections of the same column.

OUTLINE FOR EXAMINATION OF CRYSTAL GRAINS

UNIAXIAL

ORIENTATION OF SECTION	OPTICAL REACTION IN PARALLEL LIGHT AND CROSSED NICOLS	OPTICAL REACTIONS IN CONVERGENT LIGHT WITH CROSSED NICOLS AND BERTRAM LENS OR WITH CROSSED NICOLS AND EYEPIECE OUT —INTERFERENCE FIGURE—	OPTICAL REACTIONS WITH ACCESSORIES	MEASUREMENT OF INDICES OF REFRACTION
Light emerging along optic axis.	Minimum birefringence, and can show uniform intensity through 360° revolution.	A dark cross is evident, centered in field, or nearly so; as stage is revolved the cross does not revolve.	For positive minerals 	Section appears isotropic; ordinary ray, ω, only can be determined; ω is broadside and gives full value in any direction.
Light emerging at wide angle to optic axis	Intermediate birefringence.	The center of the cross is off the center of the field, but as cross-center rotates around field the extension of the arms of the cross pass across the field. 	For positive minerals 	Line from the center of interference figure cross to center of field is projection of optic axis and vibration direction of ϵ, but index of ϵ is not true until optical axis is tilted completely broadside; ω vibrates 90° to ϵ and is always a true value.
Light emerging normal to optic axis.	Maximum birefringence.	Optic axis is horizontal (broadside); only a flash figure is evident, it is in and out in 10° to 15° stage revolution; two very indistinct hyperbolas flash into clear field in opposite quadrants and emerge from adjacent quadrants.	Note: All of above reactions with accessories apply to either of adjacent quadrants when the crystal is negative.	Line separating entering and emerging hyperbolas (convergent light) is direction of optic axis and vibration direction of ϵ; ϵ is broadside and at 90° ω is broadside; to determine which is faster ray is check on sign of mineral as determined by accessories.

BIAXIAL

ORIENTATION OF SECTION	OPTICAL REACTION IN PARALLEL LIGHT AND CROSSED NICOLS	OPTICAL REACTIONS IN CONVERGENT LIGHT WITH CROSSED NICOLS	OPTICAL REACTIONS WITH ACCESSORIES	MEASUREMENT OF INDICES OF REFRACTION
Light emerging along optic axis.	Minimum birefringence, and can show uniform intensity through 360° revolution.	Only one line or brush is evident. It revolves opposite to stage; center of rotation of brush is emergence of optical axis; brush is straight at 90° position and curved at 45° position; curvature is indication of optic angle size. 	For positive minerals 	Vibration direction of the optic normal Y is tangent to the curve at 45° position; it is broadside, hence full value for β. If emergence of optic axis is perfectly centered, the equivalent of β can be measured in any direction.
Light emerging along acute bisectrix.	Low to intermediate birefringence.	If perfectly centered and angle is small, the figure is If optic angle is large, hyperbolas are seen except possibly at 45° position, stage rotation (hyperbolas entering to hyperbolas emerging) is greater than 35° for lower indices and greater than 30° for higher indices.	If optic angle is near 90°, accessories are useless. 	Center line through hyperbolas at 45° is vibration direction of B_{x_0} (broadside). Positive $B_{x_0} = X\ (\alpha)$ Negative $B_{x_0} = Z\ (\gamma)$ Tangent to hyperbolas at 45° is vibration direction of optic normal $Y(\beta)$ (broadside)
Light emerging along obtuse bisectrix.	Intermediate birefringence.	Hazy hyperbolas seen except at 45°; stage rotation (hyperbolas entering to hyperbolas emerging) is less than 35° and more than 15° for low indices and less than 30° for high indices.		
Light emerging along optic normal.	Maximum birefringence.	A flash figure only, is evident (10°-15° rotation), two opposite, indistinct hyperbolas flash in and emerge from adjacent quadrants.	Note: All of above reactions with accessories apply to either of adjacent quadrants when the crystal is negative.	Line separating entering and emerging hyperbolas = vibration direction of B_{x_a}. Positive $B_{x_a} = Z\ (\gamma)$ Negative $B_{x_a} = X\ (\alpha)$ X and Z (broadside), at right angles

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Schurecht, H. G., 49, 53, 55.
Schwartzwalder, K., and King, R. M., 38.
Schwarz, Robert, 60.
Schwarz, Robert, and Merck, Herbert, 60.
Schwarz, Robert, and Riedt, Erich, 50.
Scott, A., 58.
Seaver, K., 58.
Seil, G. E., 56.
Selfridge, G. C., Jr., 57.
Shannon, E. V., 53.
Shaub, B. M., 45.
Shearer, W. L., and Wyckoff, W. R., 60.
Shelton, G. R., 37, 52.
Shigemune, Ryoichi, 59, 60.
Short, M. N., 36.
Silk, K., 57.
Simonds, H. R., 48.
Simpson, H. E., 59.
Sims, C. E., Wilson, Hewitt, and Fisher, H. C., 34.
Sitz, G., 50.
Škola, Vladimir, 50.
Slawson, C. B., 45.
Slawson, C. B., and Peck, A. B., 47.
Smirnov, N. N., 58.
Sokolov, G. A., 60.
Solodovnikova, L., 60.
Somers, R. E., 53.
Sosman, R. B., 36, 52, 55, 56, 57, 58.
Spence, H. S., and Light, Margaret, 54.
Springer, L., 41, 42.
Sprunk, G. C., and Thiessen, R., 44.
Stein, John G., and Co., 34.
Steinhoff, E., 58.
Stone, R. H., 56.
Stranski, I. N., and Kaischew, R., 44.
Stuckert, L., 38.
Stuckey, J. L., 53.
Sueno, T., 45, 47.
Sullivan, J. D., 49.
Swenson, J. A., and Flint, E. P., 38.
Swift, James, and Son, Ltd., 45.
Syromyatnikov, F. V., 49.

Tadokoro, Yoshiaki, 55.
Takamatsu, A., 41.
Taliaferro, N. L., 55.
Tarr, W. A., and Keller, W. D., 55.
Tavasci, B., 38.
Thackwell, F. E., 48.
Thiessen, G., Ball, C. G., and Grotts, P. E., 44.
Thiessen, Reinhard, 56.
Thiessen, Reinhardt, and Sprunk, G. C., 44.
Thompson, C. L., 39, 42, 60.
Thomson, Ellis, 48, 52.
Thorvaldson, T., Brown, W. G., and Peaker, C. R., 50.
Thorvaldson, T., and Grace, N. S., 37.
Tickell, F. G., 36.
Tomkeiff, S., 53.
Toropov, N. A., 44.
Travis, C., 49.
Trefethen, J. M., 39.
Trömel, Gerhard, 43.
Trostel, L. J., 45, 53, 57.
Tunell, George, 49.
Tunell, G., and Morey, G. W., 49.

Uneno, Zenziro, 58.

Vail, J. G., 55.
Vanderwilt, J. W., 45.
Van Nieuwenburg, C. J., 50.
Van Nieuwenburg, C. J., and De Nooijer, C. N. J., 50.
Vassar, H. E., 49.
Vernadsky, W. J., 51.
Vesterberg, K. A., 51.
Vieweg, H. F., 54.
Vogel, Phillip, 44.
Vogt, J. H. L., 38.

Wagner, Hans, 48.
Wartenberg, H. von, and Gurr, W., 50.
Wartenberg, H. von, and Reusch, H. J., 50.
Wartenberg, H. von, and Werth, H., 50.
Washburn, E. W., and Bunting, E. N., 50.
Washburn, E. W., and Navias, Louis, 52.
Watson, H. L., 52.
Watson, W., and Craddock, Q. L., 38.
Watts, A. S., 59.
Weil, R., 52.
Weinschenk, E. H. O. K., 36.
Weiser, H. B., and Moreland, F. B., 40.
Wells, L. S., 37.
West, C. D., 46.
Westman, A. E. R., 56, 57, 60.
Wetzel, Kurt, 60.
Wetzel, Rudolf, 52.
Weymouth, A. A., 48.
Wherry, E. T., 35, 53.
Wherry, E. T., Ross, C. S., and Kerr, P. F., 53.
White, J., Howat, D. D., and Hay, R., 50.
White, W. P., 55.
Wightman, E. P., 48.
Wildman, J. D., 48.
Wilm, D., Hofmann, U., and Endell, K., 54.
Winchell, A. N., 36, 39, 43, 49, 55.
Winchell, N. H., and Winchell, A. N., 36.
Winkelman, H. A., and Croakman, E. G., 43.
Winter, H., and Hupe, R., 52.
Winterkorn, H., and Baver, L. D., 54.
Wolf, J., 43.
Wood, J. F. L., Houldsworth, H. S., and Cobb, J. W., 52.
Wood, R. G., and Ayliffe, S. H., 45.
Wright, F. E., 38, 39, 43, 44, 45, 46, 47, 48, 49.
Wysor, D. C., 34.

Zemyatchenskiĭ, P. A., 51, 53.
Zimmer, D. C., and Neff, J. M., 50.
Zirnowa, Nina, 50.
Zwetsch, A., and Buecking, W., 52.

ACTIVITIES OF THE SOCIETY

NOMINATING COMMITTEE REPORT FOR 1937 OFFICERS

By unanimous vote of Committees A and B on Nominations, the following names have been submitted to be balloted on by the members of the American Ceramic Society:

President, Robert B. Sosman, United States Steel Corp., Kearny, N. J.
Vice-President, Victor V. Kelsey, Consolidated Feldspar Corp., Trenton, N. J.
Treasurer, C. Forrest Tefft, The Claycraft Co., Columbus, Ohio.

WOLFRAM ENAMEL DIVISION TRUSTEE

The results of the ballot for Trustee of the Enamel Division show that Harold G. Wolfram of Porcelain Enamel and Mfg. Co., Baltimore, Md., has been elected to that office. —B. J. SWEO, *Secretary*

REFRACTORIES DIVISION ELECTS OFFICERS

The results of the election of officers for the Refractories Division 1937–38 are as follows:

Chairman, Hobart M. Kraner, Research Dept., Bethlehem Steel Co., Bethlehem, Pa.
Vice-Chairman, Nelson W. Taylor, Pennsylvania State College, State College, Pa.
Secretary, S. F. Walton, Exolon Co., Blasdell, N. Y.
Trustee Representative, C. E. Bales, Ironton Fire Brick Co., Ironton, Ohio.

Nominating Committee: R. B. Sosman, U. S. Steel Corp., Research Lab., Lincoln Highway, Kearny, N. J.; R. E. Birch, Harbison-Walker Refractories Co., Pittsburgh, Pa.

—NELSON W. TAYLOR, *Secretary*

MICHIGAN-NORTHWESTERN OHIO SECTION

Francis C. Flint, President of the American Ceramic Society, addressed a dinner meeting of the Michigan-Northwestern Ohio Section on January 15, 1937, at the Durant Hotel, Flint, Mich. Mr. Flint told in a most entertaining way of his many experiences, as President of the Society, on his trip to Europe during the past summer to attend the International Glass Conference in London and to visit various countries. Thirty-five members of the Section attended.

February 26 Meeting

The next meeting is to be held in Mt. Clemens, Mich., on February 26, 1937. Ross Purdy, General Secretary and Editor of the American Ceramic Society, will be the speaker.

—KARL SCHWARTZWALDER, *Secretary-Treasurer*

CHICAGO SECTION

On January 22, 1937, the Chicago Section of the American Ceramic Society held a joint meeting with the Chicago Section of the American Chemical Society at the Stevens Hotel, Chicago. The principal speaker was C. W. Parmelee, head of the Department of Ceramic Engineering, University of Illinois, who spoke on "Some Fundamentals of Ceramics."

CALIFORNIA SECTION

A most enthusiastic meeting was held January 7 in honor of Ross C. Purdy, General Secretary, American Ceramic Society. More than one hundred members of the California Section were present.

Dr. Purdy's address held the undivided attention of every member in the room. Under the title, "One Hundred Fifty years of Ceramics in America," Dr. Purdy briefly outlined the early history of the development of ceramics and again and again astonished his listeners with facts that gave abundant evidence of much ceramic invention among the early American workers.

Carrying his listeners through the various stages of ceramic development in this country, Dr. Purdy concluded with a series of suggestions for the betterment of the industry and for effective changes in the general policy of ceramic education.

Dr. Purdy's visit to the Pacific coast this year has been of the utmost value in "selling" the American Ceramic Society to the local fraternity. It is the hope of every prominent member of the California Section that this year's visit may be followed by others annually and that in such manner an effective liaison may be maintained between the parent organization and the Local Section.

The following officers were elected to serve during the current year:

Chairman, Elwyn L. Maxson, 112 West Ninth St., Los Angeles, Calif.
Vice-Chairman and Corresponding Secretary, Thomas S. Curtis, Box 383, Huntington Park, Calif.
Secretary-Treasurer, Hobert R. Goodrich, 469 West Oak St., Glendale, Calif.

—THOMAS S. CURTIS

PITTSBURGH SECTION

At the January Meeting of the Pittsburgh Section, held in the Fellow's Room at Mellon Institute on January 12, the following officers for 1937 were elected and installed:
Chairman, E. C. Petrie, Mellon Institute, Pittsburgh, Pa.
Vice-Chairman, D. G. Bennett, Mellon Institute
Secretary, W. C. Rueckel, Koppers Co., Pittsburgh, Pa.
Treasurer, J. W. Hepplewhite, The Edwin M. Knowles China Co., East Liverpool, Ohio.

A. P. Thompson, Carborundum Company Fellow at Mellon Institute, presented a talk on "Super-Refractories" and also a two-reel picture on the same subject. One

of the reels in color (Kodachrome process) showed the physical structures of a number of refractory materials as viewed with the petrographic microscope. The other reel portrayed the rates of solution of various refractories in basic and acidic glasses as viewed with a thermal microscope.

—W. C. RUECKEL, *Secretary*

Revision of Membership Lists

The following notice has been sent to members of the Pittsburgh Section concerning their membership status. This idea of keeping prospect and membership lists checked is heartily indorsed by the Secretary of the Society.

The Pittsburgh Section mailing list is undergoing revision. By making use of the Roster published in the October, 1936, *Bulletin*, the names of about sixty ceramists were added. This swells the prospect list to more than 250 names.

Next, the tricky business of paring the list down must be undertaken because the treasurer can not continue to finance printing and mailing on such a scale without more income. It will be found that a few members are no longer in the area. Their names can come off. A considerable discrepancy will still exist between the tally of membership dues ($1.00 per year) paid and the number of members on the list.

It has been suggested that the treasurer's records be consulted on the assumption that the non-payment of dues indicates a lack of interest in the Section. So the members, both new and old, are urged to reach an understanding with the newly elected Treasurer, J. W. Hepplewhite, if they wish to continue to receive notification of the various local activities.

CENTRAL OHIO SECTION

Members of the Central Ohio Section met at Lord Hall, Ohio State University, Friday evening, January 29, 1937. The speaker for the evening was Wilber Stout, State Geologist of Ohio, who spoke on "The Clay Resources of Ohio."

The following officers were elected for 1937–38:

Chairman, M. C. Shaw, Edward Orton, Jr., Research Foundation.
Secretary, T. W. Garve, 235 West Tenth Avenue.
Councillor, J. L. Carruthers, Ohio State University.
Program Chairman, J. O. Everhart, O. S. U. Engineering Experiment Station.

Dr. Marshall to Address March Meeting

A joint meeting of the Central Ohio Local Section, the Local Section of the American Chemical Society, and the members of the Graduate School, Ohio State University, will be held on March 12. Charles E. Marshall, Dept. of Soils, University of Missouri, Columbia, Mo., will be the speaker. His subject will be "The Constitution of Clays."

ST. LOUIS SECTION

March 5, Afternoon and Evening Sessions

Members of the St. Louis Section will meet on March 5, 1937. Among the speakers to be heard on the programs are Ross C. Purdy, American Ceramic Society; C. W. Parmelee, University of Illinois; C. M. Dodd, Missouri School of Mines and Metallurgy; and J. L. Crawford, Walsh Refractories Co., St. Louis, Mo.

—J. W. WRIGHT, *Chairman*

NEW MEMBERS*

Corporation

ALUMINUM ORE CO., J. Morrow (voter), 3500 Missouri Ave., East St. Louis, Ill.
CROSSLEY MACHINE CO., William J. Harris (voter), Trenton, N. J.
POMONA TILE MFG. CO., R. J. Schroeder (voter), 629–33 N. LaBrea Ave., Los Angeles, Calif.
TYGART VALLEY GLASS CO., E. A. Hinkins (voter), Washington, Pa.
VITREFRAX CORP., R. W. Ellison (voter), 5050 Pacific Blvd., Los Angeles, Calif.

Personal

*ABNEY, CHARLES L., 546 Stockton St., Jacksonville, Fla.; superintendent, Florida Brick and Tile Corp.
CASE, V. B., Paper Makers Importing Co., Easton, Pa.; eastern representative.
CUMMINGS, JOHN M., Department of Mines, Victoria, British Columbia, Canada; geologist.
BARTLETT, ADELBERT M., R. Guastavino Co., 660 Main St., Woburn, Mass.; superintendent.
ELLIS, FRANK, Frankoma Potteries, Inc., 719 Lindsay, Norman, Okla.; vice-president and fiscal agent.
*FELLOWS, R. L., 327 Ashland Ave., La Grange, Ill.; ceramic engineer, Chicago Vitreous Enamel Product Co., Cicero, Ill.
*GROSSMAN, HAROLD, 10 Mountainside Park Terrace, Montclair, N. J.
HALE, EDWIN, 32 Birch Ave., Birch Lynn, Wheeling, W. Va.; plant manager, Warwick China Co.
LIMES, ROBERT W., Mellon Institute, Pittsburgh, Pa.; Refractories Fellowship, junior fellow.
MADDOCK, J. B., Paper Makers Importing Co., Easton, Pa.; ceramic engineer.
*MARTIN, WESLEY G., 6054 N. Kent Ave., Milwaukee, Wis.; director of enamel research, A. O. Smith Corp.
*MONG, LEWIS E., Apt. 303, 3525 Davenport St., N. W., Washington, D. C.; assistant ceramic technologist, National Bureau of Standards.
*PHADKE, VISHNU S., Central Potteries, Ltd., Nagpur, India; managing director.
*PHILLIPS, JAMES G., Mines Branch, Sussex St., Ottawa, Ont., Canada; ceramic engineer, Department of Mines of Canada.
POLES, ALFRED P., 48 Ackerman Ave., Clifton, N. J.
SHOBERT, ERLE I., II, Stackpole Carbon Co., St. Marys, Pa.; research engineer.
SMITH, E. H., Paper Makers Importing Co., 525 E. Lincoln Way, Lisbon, Ohio; western representative.
*SQUIER, LYMAN R., Laclede-Christy Clay Products Co., 4452–58 Fifth Ave., Chicago, Ill.

Student

BROOKS, SYDNEY J., Ohio State University.
DAY, JACK F., Ohio State University.
FRÉCHETTE, VAN DERCK, New York State College of Ceramics.
HATCH, EDWIN F., Rutgers University.
KOLSTAD, JOHN H., New York State College of Ceramics.

* Indicates former member of the Society rejoining for 1937.

SNYDER, ERNEST B., Ohio State University.
SOLOMON, ROBERT, University of Alabama.
SOLOMON, VICTOR J., Ohio State University.

MEMBERSHIP WORKERS' RECORD

Corporation		Personal	
T. S. Curtis	1	Malcolm Blodgett	1
L. C. Hewitt	1	Charles Brian	3
M. E. Holmes	1	George T. Faust	1
Office	2	Earl C. Petrie	1
		J. J. Svec	1
		Office	11

Student

Howells Fréchette	1
M. E. Holmes	1
T. N. McVay	1
Office	5
Grand Total	**31**

ROSTER CHANGES*

Personal

ARNOLD, R. E., 199 Pfeiffer Ave., Akron, Ohio. (Dover, Ohio)
BAKER, JULIUS, 835 St. Agnes Ave., Dayton, Ohio. (Columbus, Ohio)
BURLINGAME, HOWARD G., 930 Eddy Rd., Cleveland, Ohio. (Kankakee, Ill.)
FRANK, HENRY A., National Helfrich Potteries Co., Evansville, Ind. (Rayo, New Mexico)
KENNADAY, CLINTON R., 325 East Wallace Ave., New Castle, Pa. (Woodbridge, N. J.)
MCMAHON, JOHN F., Alfred, N. Y. (Ottawa, Ont., Canada)
NORTON, CHARLES L., JR., Babcock & Wilcox Co., 19 Rector Bldg., New York, N. Y. (Cambridge, Mass.)
OWENS, CHARLES W., JR., P. O. Box 444, Fairfield, Ala. (Birmingham, Ala.)
REIMERS, JOHN C., 194 Beebe Court, Elyria, Ohio. (Lakewood, Ohio)
ROSENBLOOM, JERRY A., 4309 Evans, St. Louis, Mo. (Rolla, Mo.)
SCHOTTS, WALTER H., Crooksville, Ohio. (Columbus, Ohio)
STAFFORD, W. L., Globe Brick Co., East Liverpool, Ohio. (Manville, N. J.)
WATT, LOREN, Watt Pottery Co., Crooksville, Ohio. (Roseville, Ohio)

* Address in parentheses is the old address.

NECROLOGY

Elizabeth Gray Overbeck

Elizabeth Gray Overbeck passed away after a long illness December 1, 1936, at her home in Cambridge City, Indiana, where she had lived nearly all of her life.

She attended the public schools there and was graduated from the local high school. It was not until after a number of years spent in the care of her parents that she took a special course in ceramics in 1909 to 1910 at the New York State School of Clayworking and Ceramics (now N. Y. State College of Ceramics) Alfred, N. Y., under Charles F. Binns. She became a member of the American Ceramic Society at this time.

In 1911, in association with three sisters, artists and designers, she established a small art pottery, called Overbeck Pottery, with studio and workshop in their home, producing a small output of specially designed wheelmade and handbuilt pottery. Through long, painstaking effort she developed a product that has always been characterized by very fine technique, originality, and great artistic value. Her work has appeared in a great many exhibitions in various parts of the country. She was made a Fellow of the American Ceramic Society in March, 1936.

Elizabeth Gray Overbeck

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FOR INFORMATION AND SAMPLES WRITE TO
CELO MINES, INCORPORATED
BURNSVILLE, NORTH CAROLINA

THIRTY-NINTH ANNUAL MEETING OF THE AMERICAN CERAMIC SOCIETY

Waldorf-Astoria Hotel, March 21-27, 1937

General Sessions Program, Monday, March 22

10:30–11:00 A.M. President's Address
By Francis C. Flint, Hazel-Atlas Glass Co., Zanesville, Ohio

11:00–11:30 A.M. Perspective in Relation to Research
By James G. Vail, Philadelphia Quartz Co., Philadelphia, Pa.

11:30–12:00 M. Silicate Science
By George W. Morey, Geophysical Laboratory, Washington, D. C.

2:00– 2:30 P.M. Accrediting Engineering Curricula by E.C.P.D.
By H. P. Hammond, Regional Chairman, New England Section, Engineers' Council for Professional Development

2:30– 3:00 P.M. Adsorptive Clays
By Paul F. Kerr, Columbia University, New York, N. Y.

3:00– 3:30 P.M. TVA Ceramic Research
By Robert E. Gould, TVA, Norris, Tenn.

Edward Orton, Jr., Memorial Lecture

Sponsored by the Fellows of the American Ceramic Society

TUESDAY, MARCH 23, 9:00 P.M.

Pyrometry and the Steel Maker's Refractory
By R. B. Sosman, Research Lab., United States Steel Corp., Kearny, N. J.

Eight Simultaneous Division Meetings

Programs for each of the eight Industrial Divisions have papers that deal with product and plant problems and also with the fundamental sciences involved in ceramic ware compounding and processing.

Each of these eight programs will be, to those who attend this Meeting, the equivalent of thousands of dollars of research and experience.

Exhibits

There have been inquiries as to the privilege of exhibiting. No formal or commercial exhibit of the Society will be held, but persons who desire to have exhibits at the Waldorf-Astoria may make arrangements with J. P. Hoenig of the Hotel.

Official Program Book

The March issue of *The Bulletin* will be the Program Book. Issued on March 15 with the Program in detail and with abstracts of each paper, it will be used at the Meeting as the Program Book.

Advertising

Sales messages will have added effectiveness in this Program Book. The space rates are as follows:

Display Advertising Rates

(a) Space	Number of Insertions (1)	(3)	(6)	(12)
Full Page	$60.00	$54.00	$48.00	$40.00
Half Page	33.00	30.00	27.00	24.00
Quarter Page	18.00	16.50	15.00	13.50
Eighth Page	9.75	9.00	8.25	7.50

(b) Preferred Positions

Back cover: List plus 25%
Inside back cover: List plus 20%
Opposite inside back cover: List plus 20%
First page preceding reading: List plus 20%
First page after reading: List plus 20%
Inside front cover: List plus 20%
Fractional pages next reading matter: List plus 15%
Color rates: On application

Plant Trips

Plant trips to the various ceramic plants in the locality are being planned.

Entertainment

The art museums, galleries, and broadcasting stations have special features provided. These will be scheduled.

The President's Reception and Concert on Sunday night and the party on Monday night will be the only scheduled entertainment events at the Hotel. On Wednesday night, the members of the Society will select their place of entertainment and the Local Committee will make arrangements for reservations.

Registration Fee

The registration fee will be $3.00 for men and ladies; student members, $1.50.

Delegates from the German Ceramic Society

A party of about forty members of the German Ceramic Society will be the guests of the American Ceramic Society on Sunday and Monday.

Food Prices at the Waldorf

The members of the Society are assured that the meals at the Waldorf-Astoria need be no higher than elsewhere. For instance, the Savarin room serves breakfasts at 35 and 40 cents, luncheon at 75 cents, and dinner at $1.00.

The Norse Grill serves breakfast at 75 cents, luncheon at $1.50, and dinner at $2.00.

The Men's Bull and Bear Bar serves dinner at $1.50 and $2.00.

Other dining rooms in which music and entertainment are featured are higher priced.

THE WALDORF-ASTORIA HOTEL AS MEETING HEADQUARTERS

The management of the Waldorf-Astoria is anxious to prove its hospitality to members and guests of the American Ceramic Society at its Thirty-Ninth Annual Meeting. The Hotel is a landmark in the history of New York City. It is a beautiful Hotel and it is also noted for its friendliness and the efficient care of its guests.

THERE IS NO SIT-DOWN STRIKE OF CREW OF GOOD SHIP CERAMICS

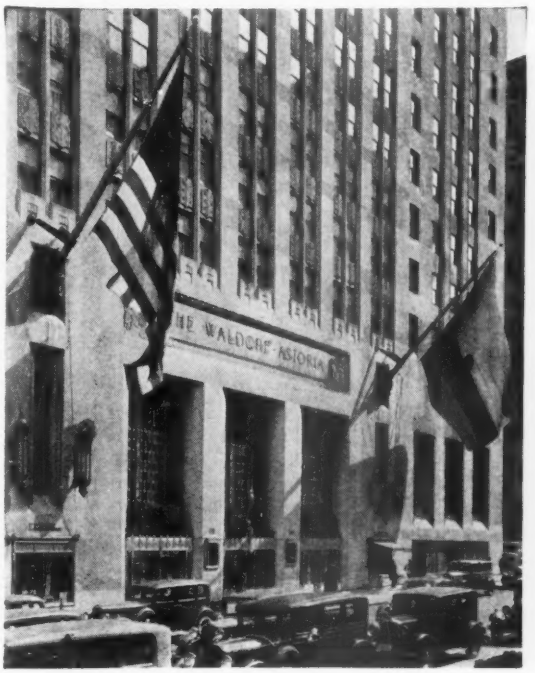
The following record shows the increased interest in coöperation for the advancing of your ceramic welfare. This record points to the larger coöperation which can and which will be had in 1937.

PAID MEMBERSHIP STATUS

Date of Record	Personal	Corporation
December 31, 1935	1248	187
November 20, 1936	1392	186
Joined as of 1937	15	
New Members as of		
January 1, 1937	45	8
February 1, 1937	26	5
Total January 20, 1937	1478	199

This membership increase is the result of personal efforts of the members of this Society. It will be these personal sales efforts that will maintain this increase during 1937.

This Society is an organized opportunity: your opportunity.



CERAMIC EXTENSION COURSE AT PENN STATE COLLEGE

The Division of Mineral Industries Extension of The Pennsylvania State College is now prepared to offer a program of adult education to workers in the great ceramic industries of this State. It has prepared a three-year course of study which is designed to give the worker in the plant the training necessary for him to assume positions of greater responsibility in the industry, to handle better the new processes developed by research, and to correlate his practical understanding with the technical aspects of the industry.

The ceramic industry is making great strides in technical advancement. Naturally, the present employees must be trained to accept positions of greater responsibility which follow naturally the advancements of science and technology. The extension course of the Pennsylvania State College is designed especially to meet that contingency and fill the need for more technical training for those men who have an earnest desire to advance.

The extension course in ceramics will be three years in length, and one textbook will be prepared for each year of the work. All of the textbooks will be prepared by the Extension Division with the assistance of members of the teaching and research staffs of the resident department of Ceramics. Each year of the course will constitute one hundred and twenty (120) hours of class instruction and upon completion of each year's work, the student will be awarded a certificate worth 8 industrial points; when he has completed the entire course, he will be awarded an extension diploma in ceramics.

The first year of the course is preparatory, dealing with such subjects as elementary mathematics, chemistry, physics, electricity, pyrometry, fuels and combustion, water and lubricants, furnace design and construction, and kilns.

The second year will be comprised of the subjects: geography, general geology, mineralogy, the geology of ceramic materials, mining and preparation, beneficiation, handling and storage, melting and crystallization of silicates, and the heat treatment of ceramic materials.

The third year course will be optional, and the student may elect to study any one of the following subjects: refractories; heavy clay products and whiteware; glass and enamels; Portland cement, limes, and plasters.

After he has finished his third-year option, the student may, in order to broaden his horizon, elect any of the other third year options. He will thus have available seven continuous years of study in the field of ceramics.

Edward P. McNamara is supervisor.

—H. B. NORTHRUP, *Director, Mineral Industries Extension, Pennsylvania State College*

POST-MEETING CRUISE TO HAVANA AND NASSAU, MARCH 27 TO APRIL 4

Following the strenuous activities of technical and committee meetings and social events at the Thirty-Ninth Annual Meeting of the American Ceramic Society in New York, March 21 to 27, inclusive, members are offered a week's cruise to Havana and Nassau. Many members will welcome the rest and change of scene before returning to their business responsibilities.

The following Cruise schedule has been offered by Thos. Cook & Son-Wagons-Lits Inc., of New York, N. Y.

Saturday, March 27: Sail 5 P.M. from New York, Hamburg-American Line SS NEW YORK
Sunday, March 28: At sea
Monday, March 29: At sea
Tuesday, March 30: Arrive Havana about 8 A.M.; the ship is your hotel without extra cost at Havana; time for sightseeing and various other entertainments.
Wednesday, March 31: In Havana
Thursday, April 1: Sail from Havana at 1 A.M.
Friday, April 2: Arrive Nassau early morning; time for swimming, golf, and other sports; sail from Nassau at 2 P.M.
Saturday, April 3: At sea
Sunday, April 4: Arrive New York at 4 P.M.

Fare, $95.00 and up, per person, including transportation, stateroom accommodations, meals, and shipboard entertainment. H. H. Allen, Manager of the Convention Department, Thos. Cook & Son-Wagon-Lits Inc., 587 Fifth Avenue, New York, N. Y. will furnish additional information upon request from members of the Society.

The Capitol and the Prado, Havana.

ANNUAL MEETING SCHEDULE

Time	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
Forenoon		Ceramic Education Committee	General Session Business Meeting	Division Meetings	Division Meetings	Division Meetings Trips	Trips
Noon		Board of Trustees and Committee Luncheons	A.S.T.M. Committee C-8	Division Luncheons	General Committee Business Luncheon Meetings		
Afternoon	Board of Trustees	3:00 p.m. Ceramic Educators	2:00 p.m. General Session 4:00 p.m. Fellow Business Meeting	Division Meetings	Division Meetings	Trips	Trips
Dinner		Meetings of (1) Div. Officers (2) Local Section Officers	School Alumni Reunions	Student Branch Dinner Meeting	Keramos Dinner Meeting		
Evening	Board of Trustees	Standards Committee President's Reception Concert	Get-Together Party	8:00 p.m. Installation of Officers 9:00 p.m. Orton Memorial Fellow Lecture	A.S.T.M. Committee C-3 A.S.T.M. Glass		

CONFERENCE ON FORMATION OF A.S.T.M. COMMITTEE ON GLASS

Held at U. S. Bureau of Mines, Pittsburgh, Pa., January 5, 1937

(1) Those present at the conference were as follows:

Representing the American Ceramic Society

W. C. Taylor, Corning Glass Works, Corning, N. Y., Chairman, Standards Committee, Glass Division, American Ceramic Society
J. S. Gregorius, Pittsburgh Plate Glass Co., Creighton, Pa., Chairman, Glass Division, American Ceramic Society
R. W. Wampler, Libbey-Owens-Ford Glass Co., Toledo, Ohio
G. W. Morey, Geophysical Laboratory, Washington, D. C.
H. H. Blau, Macbeth-Evans Glass Division of Corning Glass Works, Charleroi, Pa.
F. C. Flint, Hazel-Atlas Glass Co., Zanesville, Ohio, President, American Ceramic Society

Representing American Society for Testing Materials

A. C. Fieldner, President, A.S.T.M., U. S. Bureau of Mines, Washington, D. C.
C. L. Warwick, Secretary-Treasurer, A.S.T.M., Philadelphia, Pa.
Dean Harvey, Chairman, Pittsburgh District Committee, Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa.
W. A. Selvig, U. S. Bureau of Mines, Pittsburgh, Pa.

(2) Mr. Taylor outlined the international situation as it pertains to efforts to develop glass standards and mentioned the desire of the American Ceramic Society to develop in this country a logical and effective method of American participation in any international standardization activities that might be developed. A preliminary conference with Mr. Warwick had pointed to the desirability of clearing American participation in any international movement through the American Standards Association, endeavoring at the same time to have the international movement head up in the International Standards Association. Accordingly the American Ceramic Society would like to know whether the A.S.T.M. is interested in this subject and would undertake the formation of an A.S.T.M. committee on the subject. Dr. Taylor explained that the Glass Division of the American Ceramic Society has considered this matter and desires to see standards of nomenclature and methods of test established. The division is not interested in the standardization of product.

(3) Mr. Warwick explained that he had discussed this question with the President of the A.S.T.M., Dr. Fieldner, and that they were prepared to recommend to the Executive Committee of the A.S.T.M. that a standing committee on glass and glass products be appointed for the two-fold purpose (1) of developing American standards pertaining to glass and glass products and (2) to act as the channel of American participation in the international standardization movement. Mr. Warwick also referred to the present activities in the Society respecting glass, which are confined to Committee D-9 on Electrical Insulating Materials which is studying electrical and physical properties of glass used as an insulating material. Reference was also made to the work of Committee D-15 on Thermometers and Laboratory Glassware. The activities of the new committee on glass would need to be coordinated suitably with the activities of these two other committees but this would present no particular difficulty.

(4) Mr. Gregorius expressed the opinion that it was desirable to proceed along the lines suggested. He explained that the matter had already been considered in the Glass Division of the American Ceramic Society, of which he is Chairman, and that there would be no need to go back to that Division for a further decision before action by A.S.T.M.

(5) Mr. Blau spoke of the activities of the Joint Committee on Illuminating Glasses, consisting of representatives of the American Ceramic Society, the Illuminating Engineering Society, and the American Illuminating Glassware Guild. This is a fairly well-established group of about ten persons, concerned with optical, thermal, and mechanical properties of glass used for illuminating purposes and interested also in methods of determining all of these properties. He further explained that in the illuminating field the international problem is possibly more serious than in other sections of the glass field in view of the activities of the International Illuminating Congress.

The conference considered the possibility of coördinating the work of this group with that of the proposed A.S.T.M. committee. It developed in the discussion that the A.S.T.M. committee would probably be concerned more importantly with thermal and mechanical properties and less so with optical properties. Mr. Blau said he felt that it might be arranged for the Joint Committee to look primarily to the A.S.T.M. group for the development of standards covering thermal and mechanical properties. He explained that the Joint Committee was about ready to propose the adoption of certain standards respecting nomenclature and methods of test, the latter having particular reference to tests for certain optical properties such as reflection. It, therefore, appeared to be an opportune moment to discuss with the Joint Committee the relationship of their activities to those proposed for the new A.S.T.M. committee.

(6) The conference then turned to the discussion of matters other than nomenclature and test methods that the A.S.T.M. committee might consider.

(*a*) *Chemical Analyses of Glass:* It was explained that the American Ceramic Society and G. E. F. Lundell of the National Bureau of Standards have substantially completed standards for chemical analyses of glass and that the American Ceramic Society has adopted these standards. It was suggested, however, that the A.S.T.M. might do well to consider and adopt these standards as its own and include them in its publications.

(*b*) *Raw Materials Used in Glass Manufacture:* It was the consensus of opinion that methods of testing raw materials might well be considered, but there was no need for work to be done on specifications. With respect to lime, it was pointed out that the A.S.T.M. has a Committee C-7 on Lime where standards for lime for use in the manufacture of glass could be considered. With respect to sand it was explained that the Standards Committee of the American Ceramic Society Glass Division has developed

standards and it would appear that there was probably little need for A.S.T.M. work in respect to this material. Mention was also made of other raw materials such as soda ash, litharge, and feldspar, but no specific work was suggested with respect to these materials although mention was made of the need for methods of analysis of feldspar. Finally it was emphasized that with respect to raw materials there was no international problem.

It seemed best to the conference to eliminate for the time being any thought of the A.S.T.M. engaging in this portion of the field.

(*c*) *Products Standards:* Several members of the Conference emphasized that the essential need is for standards with respect to glass rather than glass products. It was generally agreed, however, that the scope of an A.S.T.M. committee should include tests for products as well as for glass itself, but that the question of specifications for glass products should be kept in the background.

(7) *Scope:* The above discussion having cleared the way for a statement of scope, Dr. Morey proposed the following title and scope which met with general approval:

Title: Committee on Glass and Glass Products
Scope: To clarify nomenclature of and development of methods for analysis and testing glass, both as such and as specific products.

It will be noted that the statement of scope contains no reference to specifications. It was felt that the problem of specifications could be handled as it developed in the future deliberations of the committee.

(8) Mr. Warwick explained how a new committee in the A.S.T.M. is organized and distributed copies of the Society's Regulations Governing Standing Committees. The first step is the appointment by the President of the Society of a chairman *pro tem* (see Section 3 of the Regulations). After considering several suggestions for chairman *pro tem*, Dr. Morey was asked if he would undertake this chairmanship and he agreed to do so.

It was then suggested that a so-called Steering Committee be appointed by the President to serve under Dr. Morey's chairmanship which would be representative of various producer and consumer interests, with whom Dr. Morey could discuss various problems involved in the organization of the Committee on Glass and Glass Products, including personnel, activities, subcommittee organization, etc. A number of names were suggested from which the following were selected:

Suggested Personnel of Steering Committee

Chairman: G. W. Morey, Geophysical Laboratory Washington, D. C.

Representing Producers

Flat Glass: J. S. Gregorius
Containers: F. C. Flint
Specialty Products: W. C. Taylor and H. H. Blau

Representing Consumers and General Interests

Louis Navias, General Electric Co.
D. E. Sharp, Baily & Sharp, Glass Consultants
W. F. Little, Electrical Testing Laboratories
E. W. Tillotson, Mellon Institute
J. T. Littleton, Corning Glass Works, Chairman, Glass Section, A.S.T.M. Committee D-9
Representative of the automotive industry, possibly from General Motors Co.

In connection with the above list, Mr. Wampler agreed to see if he could ascertain who would be the appropriate General Motors representative on the Steering Committee. Mr. Blau promised to write to Mr. Little and to talk with Dr. Tillotson. Mr. Flint will give particular consideration to the glass container field.

(9) The above suggestions for a Steering Committee met with general approval of the conference group.

Mr. Warwick stated that he would see that suitable recommendations were made to the Executive Committee of the A.S.T.M. at its meeting on January 20. If the organization of the new A.S.T.M. Committee were authorized at that meeting and the personnel of the Steering Committee confirmed, he would extend letters of invitation to all concerned to serve on the Committee.

(10) Record is made of other suggestions of possibilities for membership on the new A.S.T.M. Committee:

Glass Containers Assn., New York City
Mr. Richardson, Westinghouse Electric and Manufacturing Co.
Mr. Rapp, New York Port Authority
Taylor Instrument Co.
Kimble Glass Co.
Heinz Co.
LeRoy Burton, Editor, Food Industries
Spencer Lens Co.
American Optical Co.

(11) Mr. Harvey then referred to plans of the Pittsburgh District Committee of A.S.T.M. for a District meeting on the evening of February 25 in Pittsburgh at which several papers on glass will be presented. He explained that he and Mr. Gregorius had already conferred on plans for this meeting and the date of February 25 had recently been confirmed. It is planned that A.S.T.M. Committee D-9, previously mentioned, will meet in Pittsburgh on February 25 and 26 and it is expected that the Glass Section of Committee D-9 will meet at the same time.

(12) It was suggested that this Pittsburgh meeting might afford a convenient opportunity for the first meeting of the Steering Committee under Dr. Morey's chairmanship. It was tentatively agreed, subject to further conference with Dr. Morey, that the meeting of the Steering Committee would be held in Pittsburgh either in the morning or afternoon of February 25, selecting a time to avoid conflict with a possible meeting of the Glass Section of Committee D-9.

—C. L. WARWICK, *Secretary-Treasurer, A.S.T.M.*

RECEIVES HONORARY DEGREE

On December 3, 1936, Alexander Silverman, Head of the Department of Chemistry in the University of Pittsburgh, delivered the Founders' Day address on the One Hundred and First Anniversary of the granting of the Charter of Alfred University, Alfred, N. Y. Following Dr. Silverman's address, "A Better World through Science," President J. Nelson Norwood conferred upon him the honorary degree of Doctor of Science.

Paying Your Dues Is Payment to Yourself

CHARLES N. BRADY

Birth and Early Boyhood

In our complicated modern civilization, many diverse talents are needed for the success of any group enterprise. One talent which is very essential, though sometimes overlooked, is the talent for organization and leadership. It is this talent amounting to genius which preëminently distinguishes Charles N. Brady and which is largely responsible for his success and the success of the companies which he founded and guided. But it is not this one talent alone which distinguishes Mr. Brady; he is known, as well, for his winning, magnetic personality, which, throughout the years of his service in the glass business, has made so many friends for him. He also had the ability to choose men and methods and then to inspire that confidence and loyalty necessary to bring out the best in each individual. Surely, with such a combination of intelligence, ability, and personality, it is not hard to understand why—and how—Mr. Brady was able to accomplish so much from such a very humble beginning.

Born May 29, 1849, in Wheeling, at that time in Virginia, he enjoyed the normal boyhood of his times. But he became early associated with the glass industry which was destined to become his life's work. At the age of eighteen, he entered the services of the Hobbs and Brockunier Glass Company of South Wheeling, as a salesman. He was successful in this work, for he had all the qualities of a good salesman. He became acquainted with many of the outstanding men in the glass business and, in a short time, he became known and recognized as an influential figure in the industry.

Mr. Brady was not long satisfied to be an employee for another entrepreneur; he was eager to try out the new ideas which his keen and active mind conceived. Therefore, in 1879, when he was urged to join in a coöperative enterprise for the purpose of organizing the Riverside Glass Company, he agreed, and he was immediately made President and General Manager of the new company. A plant was built at Wellsburg, W. Va., for the manufacture of tableware in pot furnaces. Needless to say, under Mr. Brady's competent supervision, the company prospered.

Natural Gas Used for Glass Manufacture

It was here that what is believed to be the first application of natural gas to glass manufacture was made. In 1882, a gas well had been drilled near Wellsburg, and in some way, it caught on fire. This was a spectacular sight, burning as it did for many weeks, and people flocked into Wellsburg to see it. The railroad company even ran excursion trains into the town, bringing sightseers from near and far. During this exciting time, the suggestion was made to Mr. Brady that perhaps this fuel could be used in melting and working glass. Mr. Brady's keen mind seized upon the idea at once, and he began experimenting. After many difficulties and failures, due mainly to an inability to control the pressure, a pot furnace was finally made to operate successfully on natural gas. This was, indeed, an important step forward for the entire glass industry.

The Hazel Glass Company Organized

Although the Riverside Glass Company specialized in tableware, they also made liners for Mason jar caps. This item was considered an unprofitable side line, and the company was anxious to employ its tonnage on tableware. Mr. Brady, realizing the possibilities of this item, if it could be made by a continuous melting process instead of in pot furnaces, tried to interest his partners in pushing it, but was unsuccessful. He then obtained their permission to take over this part of the business on his own account. Consequently, in 1885, he and Charles H. Tallman, of the Bellaire Stamping Company, invested $600 each, and built a plant across the street from the Riverside Company. The factory consisted of an old grist mill, which was used as a selecting and packing room, the melting tank being erected in a new building on the other end of the same city lot. In those days furnaces were "christened" with a feminine name, and "Hazel" was selected for the infant tank. This seemed good enough for practical purposes, so the firm was called "Hazel Glass Company." This was the nucleus which grew under Mr. Brady's leadership into the present Hazel-Atlas Glass Company.

By the summer of 1886, the business had developed to the point where it was necessary to provide for additional production. Mr. Brady did not consider it advisable to expand at their present location owing to the constant menace of floods; then, too, the natural gas supply at Wellsburg was becoming undependable. A new, rich gas field having just been discovered in the vicinity of Washington, Pennsylvania, the Company acquired a site in that town. The new plant at Washington had four tanks so that the plant could be operated both on day and night shifts, two tanks on day and two on night, and the idle periods used for filling and melting.

The death of Mr. Tallman, in 1888, broke up the Brady-Tallman partnership and a new arrangement was necessary to carry on the business. Mr. Brady secured the necessary capital and business personnel to form a stock company, he being chosen as general manager. The business had already outgrown the Washington plant, so a new site was acquired in the same city, and a new plant was erected where the company's Hazel No. 1 factory now stands. On May 3, 1889, "The Hazel Glass Company" was incorporated.

The Beatty-Brady Glass Company and Atlas Glass Company

Of a deep religious nature, and with a love for the artistic, Mr. Brady conceived the idea of retaining the old works for the manufacture of cathedral glass. Unwilling to hamper the Hazel Company with a business of dubious commercial success, this venture was separately organized

as the Beatty-Brady Glass Company, with R. J. Beatty, as President, and C. N. Brady, as Vice-President. Later, this Company built a new plant for the manufacture of fruit jars, under the name of "Atlas Glass Company." These were busy days for Mr. Brady, and he had many responsibilities, for he was not only the President and General Manager of the Hazel Glass Company, but he now found himself engaged in making fruit jars and cathedral glass with the Atlas Glass Company, in his capacity as Vice-President.

Glass Machine Patent Inventions

But now began the most critical period of the glass industry. Up until 1890, all glass articles were blown by mouth and lung in much the same way as depicted in Egyptian hieroglyphics. All glass manufacturers realized the desirability of a glass-blowing machine, but no steps had yet been taken to construct one. A few patents had been taken out in the late 80's which were not commercially successful. Then there happened the phenomenon which frequently occurs in history—a sudden flaring-up of invention and discovery in some particular field. The next ten years in the glass industry were hectic. Patents followed one another in rapid succession and with overlapping claims; infringement suits and counter-suits filled the courts. It was a time of confusion and despair for the executives of many glass plants, all of whom were trying to keep up with the developments of the day and yet avoid a law-suit in the courts based on the infringement of some other company's patent. Through it all, Mr. Brady's genius piloted his companies. His keen discernment was quick to realize the new order of the day. His ability, intelligence, and good judgment kept such diverse workers as machinists, inventors, and lawyers pressing forward to the new goal. Mr. Brady's policy of encouraging his men to develop new ideas in glassmaking practices has been steadfastly carried on through the years of the Company's growth, and many of the devices, which have contributed to the speed and efficiency of present-day machines and methods, were conceived and worked out in plants of the Hazel-Atlas Glass Company by employees who have become leaders in the glass manufacturing world.

The Hazel-Atlas Glass Company Organized

In 1901 the patent situation showed signs of clearing up, and in order to strengthen the organization for the harmonious development of the new machines, Mr. Brady and his two brothers, who were also interested in the glass business, decided to merge their interests. William S. Brady was at that time President of the Republic Glass Company of Clarksburg, W. Va.; Joseph C. Brady was President of the Wheeling Hinge & Metal Company of Wheeling, W. Va. The merging of these two companies with the Atlas Glass Company, of which Mr. Brady was Vice-President, was effected in November, 1901, and was called "The Atlas Glass and Metal Company." One year later, in November, 1902, the Atlas Glass and Metal Company consolidated with The Hazel Glass Company, to form "The Hazel-Atlas Glass Company," and C. N. Brady was made President, with William S. Brady, as Vice-President, and Joseph C. Brady, Treasurer.

Mr. Brady Retires in 1919

C. N. Brady served as President until December 18, 1909, when he was made Chairman of the Board of Directors, and William S. Brady was advanced to the presidency. In December, 1919, Charles N. Brady retired from active duty, William S. Brady succeeding him as Chairman of the Board, and Joseph C. Brady advancing to the presidency of the Company.

He now lives quietly in Washington, Pennsylvania, almost within the shadows of the great plants which he started and helped to build up. The steady and persistent growth of these plants is a tribute not only to his skill and judgment as a business man, but also to the high standards of quality which he set up and which have never been lowered. Although he has turned the affairs over to younger men, many of these will frequently drop around of an evening for a friendly chat and to find fresh courage and inspiration in his ripened wisdom and although Charles N. Brady enjoys recalling how the Company has grown from the little four-shop day tank in Wellsburg to the great organization operating fourteen plants throughout the country, with sales offices in nearly all of the principal cities—he likes much more to talk about his "boys"—boys he has helped and encouraged and directed. He still sees them as he first knew them in ragged, greasy overalls, but the world knows their names wherever civilized man makes glass.

NOTES AND NEWS

FIRST INTERNATIONAL EXHIBITION OF APPLIED AND SCIENTIFIC PHOTOGRAPHY

Under the chairmanship of Gustave Fassin of the Bausch & Lomb Scientific Bureau, Rochester, N. Y., a committee has been appointed to secure and arrange exhibits for the first International Exhibition of Applied and Scientific Photography ever held in the United States.

It will be held in the Rundell Memorial Building at Rochester, N. Y., in March, 1937.

Scientists are invited to send exhibits to C. B. Neblette, Secretary of the Scientific Section, Rochester Athenaeum & Mechanics Institute, Rochester, N. Y.

PITTSBURGH DISTRICT A.S.T.M. MEETING

The Pittsburgh District American Society for Testing Materials will hold a meeting at 6:30 P.M. on February 25 at the Hotel Roosevelt, Penn Avenue and Sixth Street, Pittsburgh, Pa.

The following papers will be presented:

(1) "Recent Development in the Glass Industry," by E. Ward Tillotson, Assistant Director, Mellon Institute.

(2) "Laminated Glass," by J. Hervey Sherts, Pittsburgh Plate Glass Co., Creighton, Pa.

(3) "Glass Fibres," by Games Slayter, Owens-Illinois Glass Co., Newark, Ohio.

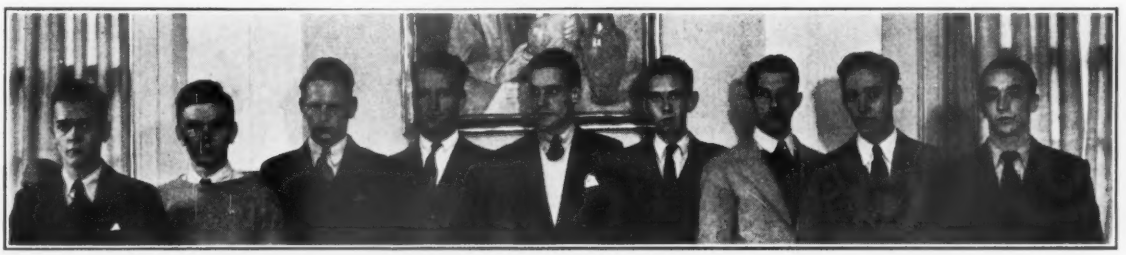
J. C. HOSTETTER VICE-PRESIDENT OF HARTFORD-EMPIRE COMPANY

John C. Hostetter, for many years the leader in the research and development program of the Corning Glass Works, has been elected Vice-President in Charge of Research and Development of the Hartford-Empire Company of Hartford, Connecticut. Doctor Hostetter is now located in Hartford, having begun his duties shortly after the first of the new year. The administration of Corning's research policy will revert to E. C. Sullivan, Vice-Chairman of the Board of Directors, and the organizer and former director of its development and research department.

The Hartford-Empire Company invents and licenses automatic equipment used by the glass industry in the United States and in seventeen countries abroad. Research achievements of Hartford-Empire are of immediate benefit to the entire glass industry. Corning Glass Works, as one of its licensees, and as the world's largest manufacturer of technical glass products, is in position to benefit by every advance in machine development.

The nomination and selection of Dr. Hostetter for the position of Vice-President and director of the research and development policies of the Hartford-Empire Company is a tribute to his unique position in the glass industry. Trained in pure science, with a background of work in the Geophysical Laboratory of the Carnegie Institution, at the Bureau of Standards, and in the Optical Section of the War Industries Board, Dr. Hostetter has attained a position of equal experience in process engineering and plant operation. He has directed extensive research programs coördinating the activities of chemists physicists, and engineers. During his many years in the employ of the Corning Glass Works, he has been successively manager of the Steuben Division, assistant to the vice-president in charge of production, manager of the Rhode Island Division, manager of bulb and tubing production, including supervision of this work at the Rhode Island, Wellsboro, and Corning divisions. Since 1930 he has been Director of Development and Research.

Simultaneously with Dr. Hostetter's election, the Hartford-Empire Company has advanced to a vice-presidency its chief engineer, Karl E. Peiler, who has been with the Company since its origin. Mr. Peiler invented the Company's basic feeding machine, the so-called "paddle needle feeder." This machine took the place of arduous hand-labor operations in transferring the molten glass from the tank to the mold. Important new developments significant to the glass industry as a whole are said to be now under way in the great research factory of the Hartford-Empire Company. Doctor Hostetter, in view of his background, will bring his rare combination of experience to bear on these technical problems. Solution of these problems may, it is believed, open fields of unlimited scope in modern glass manufacturing.



Some of the students at the New York State College of Ceramics who are identified with prominent ceramic families, and the companies with which their families are connected are as follows:
Reading from left to right they are:

(1) Walter Blundred, Onondaga Pottery Co.
(2) Olaf Loytty, Corning Glass Works
(3) Herman Schrickel, Corning Glass Works
(4) Howard Cowan, Onondaga Pottery Co.
(5) Cameron Paulin, Sovereign Pottery Co.
(6) Allan Wilson, Buffalo Pottery Co.
(7) William Frey, Carr China Co.
(8) William Knapp, Bonnot Co.
(9) Norman J. Echavarria, Loceria Colombiana, Colombia, S. A.

Others not in the picture include the following:

(10) Hernan Castro, Castro Oliveire Ceramica, Santiago, Chile, S. A.
(11) Philip Tefft, Claycraft Mfg. Co.
(12) James Wilson, Buffalo Pottery Co.
(13) Addison Scholes, N. Y. State College of Ceramics
(14) Van Derck Fréchette, Canadian Department of Mines

TENTH ANNUAL MINING INSTITUTE UNIVERSITY OF WASHINGTON

Joint Meeting with American Ceramic Society

The Tenth Annual Mining Institute of the College of Mines, University of Washington, Seattle, was held during the week from January 18 to 23, 1937. The headquarters were at Mines Laboratory and sessions were held in Mines Laboratory and other buildings on the University Campus.

Special features were a joint meeting with the American Ceramic Society on Tuesday, January 19, at which several papers dealing with the development of industrial minerals and products were presented. Ross C. Purdy, General Secretary, represented the American Ceramic Society and spoke at the evening session.

The North Pacific Section, A.I.M.M.E., met with the Mining Institute on Thursday, January 21, at which time Colin G. Fink, head of the Division of Electrochemistry, Columbia University, gave an illustrated talk on "Indus-

trial Electrochemistry," with particular reference to the manufacture of electrochemical and electrometallurgical products in the Pacific Northwest.

At the luncheon meeting on January 21, the Mines Society presented student speakers in a program devoted to mining subjects

Special speakers for the Institute were as follows:

(1) Colin G. Fink, Head, Division of Electrochemistry, Columbia University, New York City: "Industrial Electrochemistry."

(2) Ross C. Purdy, General Secretary, American Ceramic Society, Columbus, Ohio: "One Hundred and Fifty Years of Ceramics in America."

(3) A. E. Anderson, Assistant Manager, du Pont Company, Seattle: "Explosives in Prospecting and Mining."

(4) S. H. Ash, Safety Engineer, U. S. Bureau of Mines, San Francisco, Calif.: "Safety and Dividends at Small Mining Operations."

(5) Asa C. Baldwin, Civil Engineer, Seattle: "Geophysical Prospecting for Gold."

(6) C. V. Brennan, Assistant General Manager, Britannia Mining & Smelting Co., Britannia Beach, B. C.: "High Lights of Operations at Britannia Mine."

(7) H. E. Gray, Manager of Sales, Bethlehem Steel Co., Seattle: "Steel Manufacture at the Seattle Plant of Bethlehem Steel Co."

(8) C. F. Hoff, Engineer, Dorr Co., Denver, Colo.: "Adventures of a Metallurgist in the Orient."

(9) Ernest N. Patty, Vice-President and Manager, Gold Placers, Inc., Coal Creek, Alaska: "The Airplane Aids Alaskan Mining."

(10) Samuel H. Williston, Portland, Ore., Manager, Horse Heaven Mines, Inc.: "Geophysical Prospecting and Its Natural Limitations."

Members of the University staff were scheduled for the following topics: (1) Milnor Roberts, "Mining Events of the Year"; (2) Joseph Daniels, "How to Buy Coal"; (3) C. R. Corey, "Assaying and Production of Metals"; (4) G. E. Goodspeed, "Geology of Industrial Minerals"; and (5) J. Grattan O'Bryan, "Interesting Cases in Mining Law."

Student speakers and their subjects were (1) Gordon Barr, "Sampling at the Tacoma Smelter"; (2) Jack C. Lowry, "Sunset Copper Mine, Index, Wash."; and (3) William J. Roberts, "Mining Methods at Alaska Juneau Mine."

The following motion pictures were presented: (1) The Manufacture and Treatment of Bethlehem Alloy Steels; (2) Glimpses of Texas, Its Natural Resources, and the Big Bend National Park Project; and (3) Making an All-Steel Automobile Body.

Ceramic Day Program

10:00 A.M. "Washington Operations of Gladding, McBean, and Company in Ceramic and Nonmetallic Materials," by W. E. Lemley, Plant Manager, Gladding, McBean, and Co., Northern Division.

11:00 A.M. "Electric Power in Washington with Application to Ceramics," by C. E. Magnusson, Director of the Engineering Expt. Station, Univ. of Washington, and Advisor to State Planning Council.

2:00 P.M. "England's Building Program," by Joseph Demmery, College of Economics and Business, Univ. of Washington.

"Manufacture of Sewer Pipe by the Vacuum System at Taylor, Washington," by J. G. Adderson, Plant Superintendent, Gladding, McBean, and Co.

"Pottery Marketing Problems in Washington." C. R. Pate, Special Investigator, U. S. Bureau of Mines, Univ. of Washington.

"Recent Developments at the Glendale, Calif., Plant, Gladding, McBean and Co.," by Gordon Adderson, Ceramic Engineer.

"Chromite Resources of the Pacific Northwest," by Thomas L. Hurst, Research Fellow, Univ. of Washington and U. S. Bureau of Mines.

"Olivine Resources of Washington," by Robert W. Cline, Research Fellow, Univ. of Washington and U. S. Bureau of Mines.

"The Effect of Heat on Washington Soapstone," by Joseph A. Pask, Univ. of Illinois.

Demonstration of a new method for pottery model and mold preparation for ceramic classwork by J. O. Wilkinson, Univ. of Washington.

6:30 P.M. Banquet, Hotel Edmond Meany:

"One Hundred and Fifty Years of Ceramics in America," by Ross C. Purdy, Columbus, Ohio, General Secretary, American Ceramic Society.

Election of Section officers for 1937 and reports.

"Manufacture of Refractories at Mexico, Missouri." Moving picture supplied by E. J. Bartells' Company and A. P. Green Fire Brick Co.

Wednesday, January 20

10:00 A.M. Trip to Renton plant of Gladding, McBean, and Company for inspection of rebuilt face brick, fire brick, roofing tile, floor tile, new dry-press, firebrick units: new railroad tunnel kiln and driers.

12:00 M. Gladding, McBean and Company at Renton served luncheon to members Pacific Northwest Section, American Ceramic Society.

39th ANNUAL MEETING—MARCH 21-27, 1937
WALDORF-ASTORIA, NEW YORK CITY
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International Congress on Glass

(London and Sheffield, 1936)

The August, 1936, number of the "Journal of the Society of Glass Technology" contains a complete account of the Proceedings of the Congress and the first batch of ten valuable papers by authorities of international repute.

The October, 1936, number contains 27 other papers presented at the Congress.

Copies, price 10/–d. ($2.46) each, may be obtained from the Secretary, or from the American Ceramic Society.

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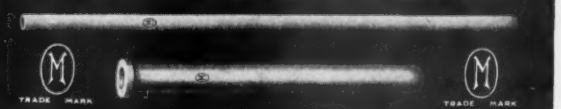

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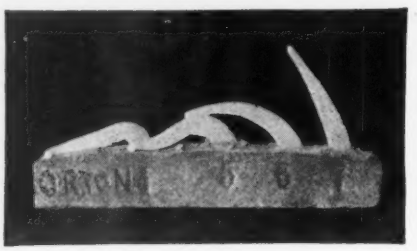

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